PERALTA COMMUNITY COLLEGE DISTRICT

BERKELEY CITY COLLEGE, BERKELEY CA

DSA #01-120312

BCC WEST
PROJECT MANUAL

DSA Submittal

Ratcliff Project Number 21415.00

July 18 2022

XL CONSTRUCTION.

RATCLIFF

ARCHITECT

RATCLIFF
5856 Doyle Street
Emeryville, CA 94608

6/16/2022

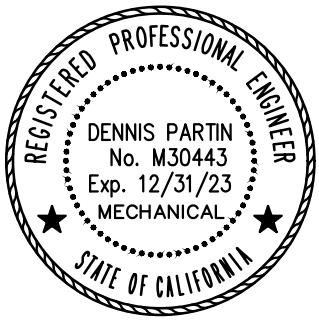
Signature **Date**

STRUCTURAL ENGINEER **DEGENKOLB ENGINEERS**
601 12th Street, Suite 400
Oakland, Ca. 94607

Signature **6/10/2022**
Date

MECHANICAL ENGINEER

FRANK M. BOOTH
251 Michelle Ct.
South San Francisco, Ca. 94080



6/15/2022

Signature **Date**

PLUMBING ENGINEER

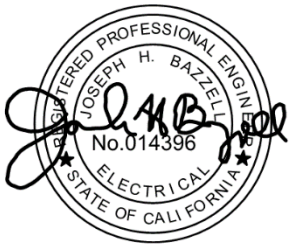
FRANK M. BOOTH
251 Michelle Ct.
South San Francisco, Ca. 94080

Dennis Partin 6/15/2022

Signature **Date**

ELECTRICAL ENGINEER

ROSENDIN ELECTRIC
2121 Oakdale Ave
San Francisco, Ca. 94124



July 18, 2022

Signature **Date**

PROJECT MANUAL

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

DIVISION 01 – GENERAL REQUIREMENTS

DIVISION 08 – OPENINGS

DIVISION 09 – FINISHES

DIVISION 10 – SPECIALTIES

DIVISION 11 – EQUIPMENT

END OF SECTION

SUBSTITUTION REQUEST FORM

Note: Failure to complete this form with complete and accurate information in a timely manner will nullify any request for substitution.

TO: _____

PROJECT: _____

We hereby submit for your consideration the following product(s), material(s), and/or detail(s) instead of the specified item per the contract documents for the above indicated project and the following specified reference:

ITEM DESCRIPTION	SPEC SECTION	SPEC PARAGRAPH	DRAWINGS

Proposed Substitution: _____

a. Attach complete technical data, including laboratory tests, if applicable.

b. Include complete information on changes to Drawings and/or Specifications, which proposed substitution would require for its proper installation.

c. Submit with this request all necessary samples and substantiating data to prove equal quality and performance to that which is specified. Clearly mark manufacturer's literature and test reports to indicated equality in performance.

d. Upon submitting any substitution, the Contractor and/or Subcontractors certify that the substituted product does not contain detectable amounts of asbestiform minerals and/or lead compounds in concentrations greater than 1/10th of 1% (0.1%).

Fill in blanks below:

A. Does the proposed substitution affect dimensions indicated on Drawings?

Yes___No___
Explanation: _____
___

_____
___

B. Will the undersigned pay for changes to the building design, including design, engineering and processing costs caused by the proposed substitution?

Yes___No___
Explanation:_____

___

_____

C. Does the proposed substitution have an effect on other trades?

Yes___No___
Explanation:_____

___

_____

D. Does the proposed substitution have an effect on applicable code requirements?

Yes___No___
Explanation:_____

___

_____

E. Outline differences between proposed substitution and specified item:

_____

_____

F. Are the manufacturer's guarantees of the proposed substitution the same as the specified item?

Yes___No___
Explanation:_____

___

_____

G. Is the proposed substitution listed with and conform to the same requirements of the same testing agencies as the specified item, such as ICBO, ASTM, etc.?

Yes___No___
Explanation:_____

___

Has the proposed substitution been accepted by DSA?

Yes ____No ____
Explanation: _____

CERTIFICATION OF EQUAL PERFORMANCE AND ASSUMPTION OF LIABILITY
FOR EQUAL PERFORMANCE BY CONTRACTOR

The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

Submitted By:

_____ _____
Signature Title

_____
Name (print)

_____ _____
Firm Date

_____ _____
Telephone

_____
Address

Remarks: _____

For Use By Design Consultant

_____ Accepted _____ Accepted As Noted _____ Not Accepted

_____ Received Too Late _____ Approved as Alternate – See Bid Form

NOTICE TO DESIGN-BUILD ENTITIES

NOTICE IS HEREBY GIVEN that the Peralta Community College District ("District") of Oakland, California, acting through its Governing Board, hereinafter referred to as the District, will accept proposals for the award of a Design Build Project.

PCCD PROJECT NO. 20-21/06
BERKELEY CITY COLLEGE- 2118 MILVIA STREET PROJECT

Each proposal must conform to and be responsive to the contract documents and be submitted on a form furnished by the District. Proposals can only be submitted by those Design-Build Entities who have been invited to submit proposals for this Project. The following firms are hereby invited to submit proposals:

1. Blach Construction Co. & Mark Cavagnero Associates
2. Turner Construction Co. & Gould Evans, Inc.
3. XL Construction Corp. & Ratcliff Architects

DETERMINATION OF BEST VALUE: The District will review proposals and request that the three (3) firms participate in an interview process. If the Contract is to be awarded, District will award the Contract to the responsive Design-Build Entity whose proposal is determined to provide the Best Value to the District. District shall provide Document 00 51 03 Notice of Award within one hundred twenty (120) calendar days of Proposal submission. District's written decision shall support the award of the Contract by stating the basis of the award.

THIS IS A LABOR AGREEMENT PROJECT: This project is subject to the terms of the Program Labor Agreement (PLA) executed between the Peralta Community College District and the Building and Construction Trades Council of Almeda County, AFL-CIO . Copies of the PLA are available as part of the DBE-RFP package, Appendix D.

PREVAILING WAGE: The successful proposer shall be required to pay its workers on this project a sum not less than the general prevailing wage rate of per diem wages and not less than the general prevailing rate for holiday and overtime work for work of a similar character in the locality in which the project is performed as provided under California Labor Code section 1770 et sec. The District has determined the prevailing rate of per diem wages and the general prevailing rate for holidays and overtime work in the locality in which this project is to be performed for each craft, classification or type of work needed to execute the work.

Design-Build Entity shall be required to post, at each job site, a copy of such prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations.

This project is a Public Works Project. All Contractors and Subcontractors must be registered with the California Department of Industrial Relations (DIR) pursuant to Labor Code Section 1773.3 for monitoring of labor compliance with DIR. For complete information, refer to the following link: www.dir.ca.gov/public-works/SB854.html

SUBSTITUTION OF SECURITIES: District will permit successful Proposer to substitute securities for retention monies withheld to ensure performance of Contract, as set forth in Document 00 57 00 (Escrow Agreement in Lieu of Retention), in accordance with California Public Contract Code, Section 22300. By this reference, Document 00 57 00 (Escrow Agreement in Lieu of Retention) is incorporated in full in this Document 00 11 13.

RESTRICTIONS ON SUBSTITUTIONS AND SOLE SOURCE ITEMS: As a limitation on Proposer's privilege to substitute "or equal" items, District has found that certain items are designated as District standards and certain items are designated to match existing items in use on a particular public improvement either completed or in the course of completion or are available from one source. As to such items, District will not permit substitution. Such items are described in the Bidding Documents.

The Peralta Community College District is an equal opportunity employer.

Board of Trustees
Peralta Community College District
Leigh Sata, Executive Bonds Manager

Published: November 23, 2020

END OF DOCUMENT

PART 1 – GENERAL

1.1 SUMMARY

1.1.1 This section provides the rules and procedures by which the District will discuss and negotiate a design build contract with the Proposers whose proposals were determined to be the most advantageous pursuant to the best value method.

1.1.2 Pursuant to the Request for Proposal, the Proposers acknowledged and agreed that by signing their proposal, the District choses to reserve for itself the right to discuss and negotiate a design build contract with the Proposers to determine which proposal is most advantageous to the District would be awarded the contract.

1.2.3 Upon reserving this right, District is required under California Education Code section 17250.25(a)(2)(C)(v) to provide the rules and procedures it shall observe to ensure that any discussions or negotiations to determine the most advantageous proposal are conducted in a fair and impartial manner.

1.2 RULES AND PROCEDURES

1.2.1 Preliminary Completeness Review. As part of the preliminary completeness review process the District may, in its sole discretion, discuss any apparently patently defective or non-responsive Proposal with the submitting Proposer to clarify or correct any errors by the District in reviewing the proposal, to request additional clarifying, instructive, advisory, or corrective information, and to otherwise determine whether a defect may be waived as inconsequential.

1.2.2. Technical Review. During the detailed technical review of Proposers' proposals the District may, in its sole discretion, submit written and/or oral questions to the Proposers regarding their proposals. Proposers must answer the District's questions in writing. The technical review question and answer process is not to be treated as an opportunity for Proposers to change or supplement their proposals; it is intended to make clear, refine or otherwise explain elements of the Proposers' technical proposals.

1.2.3. Technical Review Presentations. Should the District elect to require Proposers to make detailed technical presentations regarding the essential elements of their Proposals, on one or more Evaluation Factor Categories, the District may, in its sole discretion, ask questions of the presenters regarding the presentation topic and/or its relationship to other elements of the Proposal.

1.2.4. Requests for Supplemental Information and Proposals. The District has reserved the right to request supplemental information and proposals from the Proposers. If the District elects, in its sole discretion, to make a request for supplemental material from any Proposer, the District will make a similar request of all Proposers, with equal time for response given to all Proposers.

1.2.5. Best and Final Offer. The District may, at its sole option, either accept a Proposer's proposal by award of a contract or enter into further discussions with one or more Proposers whose proposals are deemed to be reasonably

susceptible of being considered for award. After discussions are concluded or as part of on-going contract negotiations, the District may, in its sole discretion, request a "Best and Final Offer" from one or more Proposers for consideration by the District.

1.2.6. Proposal Evaluations. The District will evaluate responsive Proposers' written proposals and assign each proposal a score pursuant to the scoring criteria described in the Request for Proposal. If there is any conflict between these Rules and the Request for Proposals, the Request for Proposals shall prevail. Special attention should be noted that the following minimum factors collectively represent at least fifty percent (50%) of the total weight of consideration given to all criteria factors in this RFP. The proposals will be ranked from lowest to highest score based on the District's evaluation of all criteria.

1.2.7. Evaluation Panel(s). The District will assemble one or more Evaluation Panels to evaluate the technical components of the Proposals. Evaluation Panels may be composed of members of the Project's construction management team, District's designated contract negotiator(s), specialists from the District's Risk Management Department, the District's Legal Office or authorized Special Counsel to the District, and other qualified individuals whose participation the District determines is necessary or appropriate.

1.2.8. Interview/Presentation Panel. The District will assemble an Interview/Presentation Panel, whose members will be similar to that of the Evaluation Panel(s) and who will score the Proposers presentations of their Proposals. Interview/Presentation Panel members will not know the initial score or rankings of the proposals assigned by the Evaluation Panel(s); if such knowledge comes to them, they will be replaced on the panel by a person of equivalent or higher level. The Interview/Presentation Panel will meet separately with each Proposer for the presentation of their proposal. Each Proposer will be asked to give a short proposal overview. To the maximum extent practical, each Proposer will address the major concerns of the Interview/Presentation Panel, and should be prepared to answer any questions that may arise as a result of the presentation. The Proposers will be chosen by lot to determine the order of presentations. Proposers will bring no more than six (6) representatives to the panel. Proposers representatives will be comprised of the team as noted in the DBE proposal only. No management nor business developing personnel allowed on the presentation team. Proposer's representatives may make a visual presentation; they may bring copies of their proposal.

1.2.9. Interview/Presentation Panel Scoring. Upon completion of each interview/presentation, each member of the Evaluation Panel will separately and confidentially score each Proposer on all criteria. The District will receive the panel member's scores, and combine them with the Proposers' scores for all Evaluation Factor Categories to come to a total score. The proposals will be re-ordered, if necessary, from lowest to highest. Upon re-ordering, the Proposers with the two highest scores will be contacted, and negotiations may commence to determine which proposal is the most advantageous to the District. If there is a tie between the 2nd and 3rd proposals, then negotiations will commence by and among the top three proposals and the District.

1.2.10. Contract Negotiations. The District will assemble a Contract Negotiation Team to engage the Proposer with the highest ranked proposal. The District may, in its sole discretion, conduct concurrent negotiations with the Proposer having the second highest ranked proposal. Upon successful conclusion of negotiations, the District will notify the Proposer having the proposal that is the most advantageous to the District.

1.3. CONE OF SILENCE.

1.3.1 "Cone of Silence" means a prohibition on any communication, oral or written, regarding particular Requests for Proposals (RFP), bids, proposals, contract negotiations, or other competitive solicitations between:

1.3.1.1 Any person who seeks an award of the Project from the District, including a Proposer or Proposer's representative, and

1.3.1.2 Any person appointed to evaluate or recommend selection in such procurement process.

1.3.2 Notwithstanding the foregoing, the Cone of Silence shall not apply to communications with, among or between the Project Manager, Criteria Architect, Construction Manager, and District Special Counsel and their respective staff, or with designated staff who are not serving on an Evaluation Panel or the Interview/Presentation Panel, to obtain clarification or information concerning the subject solicitation. Further, nothing herein shall prohibit District employees or representatives from communicating with each other. For purposes of this section, "Proposer's representative" means an employee, partner, officer, or director of a Proposer, or consultant, lobbyist, or actual or potential subcontractor or sub-consultant of a Proposer.

1.3.3 A Cone of Silence applies to this procurement as of the date this section is issued conformed for release. The Cone of Silence shall terminate at the time the SFUSD Board of Education votes to award or approve a contract, to reject all bids or responses, or otherwise take action that ends the solicitation.

1.3.4 Nothing contained herein shall prohibit any prequalified Proposer or any Proposer's representative:

1.3.4.1 from making public presentations at duly noticed pre-bid conferences or before duly noticed Evaluation Panel and/or Interview/Presentation Panel meetings;

1.3.4.2 from engaging in contract negotiations with the District;

1.3.4.3 from making a public presentation to the Board of Trustees during any duly noticed public meeting; or

1.3.4.4 from communicating in writing with any District employee or official for purposes of seeking clarification or additional information, subject to the provisions of the applicable RFP, or bid documents.

1.3.5 Nothing contained herein shall prohibit the Project Manager or other respective staff from initiating contact with a prequalified Proposer or Proposer's representative and subsequent communications related thereto for the purpose of obtaining further information regarding the RFP, bid, or competitive solicitation or as otherwise permitted by this Section. For purposes of this Section and when not otherwise precluded by the operation of this Section from doing so, the Project Manager or designee shall accept communications from prequalified Proposers or Proposer's representatives while a Cone of Silence is applicable to this competitive solicitation. Such contact shall be in writing and shall be provided to the members of the applicable evaluation, including any response thereto.

1.3.6 The District's Legal Office shall be informed of any person who is alleged to have violated the requirements of this Section. In each such instance, an investigation may be performed and the results of each investigation including a determination of violation, if any, shall be compiled in a report.

1.3.6.1 If there is a determination of violation, the District reserves the right to reprimand, penalize in the form of lower ranking or points, or entirely disqualify the Proposer who committed the violation from further consideration for the pending competitive solicitation.

1.3.6.2 A copy of the report, including a determination of violation, if any, and notice of the penalty imposed as provided for in this Section, if any, shall be immediately furnished or mailed to the Proposer or person who has been investigated.

1.3.5.4

END OF SECTION

EXISTING SITE CONDITIONS

1. This document sets forth the terms and conditions under which a Proposer may review, study, use or rely upon geotechnical data for, or areas near, the Project site (the "Site"), and existing conditions information concerning existing conditions at the Site. This document, the available geotechnical data, and the supplied existing conditions information are not Contract Documents.

2. **REPORTS AND INFORMATION.**

   2.1 District, its consultants and prior contractors have collected documents that provide a general description of the Site and conditions of the Work. These documents may consist of geotechnical reports near and around the Site, contracts, contract specifications, tenant improvement contracts, as-built drawings, utility drawings, and information regarding Underground Facilities. These reports, documents and other information are not part of the Contract Documents.

   2.2 Proposers must inspect all available geotechnical reports and all information regarding existing conditions provided by the District.

   2.3 The following reports and information regarding existing conditions and Underground Facilities at or contiguous to the Site are included with this RFP as reference documents: Refer to RFP document and District registry,

   2.4 The reports, documents, and information described herein are not part of the Contract Documents. However, for Proposer's convenience, copies of the documents have been provided with the Project Manual and Criteria Documents.

3. **USE OF INFORMATION ON EXISTING CONDITIONS.**

   3.1 Above-Ground Existing Conditions. Under no circumstances shall District be deemed to make a warranty or representation of visible existing above-ground conditions, as-built conditions, or other above-ground actual conditions verifiable by reasonable independent investigation. These conditions are verifiable by the Proposer by the performance of its own independent investigation, which the Proposer must perform prior to submitting a Proposal. The Proposer must not rely on the information supplied by District regarding existing above-ground conditions. By submitting a Proposal, Proposer represents and agrees it is not relying on any information regarding existing above-ground conditions supplied by District to the extent such conditions are verifiable by reasonable independent investigation.

   3.2 Underground Facilities. Information supplied regarding existing Underground Facilities at or contiguous to the Site is based on information furnished to District by others (e.g., the owners or builders of such Underground Facilities or others). For those Underground Facilities that are owned by District, District will be responsible for the accuracy of information regarding Underground Facilities and for any conditions that materially differ from those indicated in the information provided by the District, provided that Proposer has conducted an independent

review of the information provided by the District and discrepancies were not apparent. Proposer is responsible for understanding and interpreting all information on Underground Facilities other than those owned by District and District agrees that Proposer is not responsible for the accuracy of such information or reports. In reviewing any information regarding Underground Facilities, Proposer is responsible for making all reasonable interpretations and drawing all reasonable conclusions from that information but shall be solely responsible for any unreasonable interpretations or conclusions drawn therefrom. Compensation to the Design Builder for unknown differing site conditions shall be allowed as is provided for in the Contract Documents.

4. **LIMITED RELIANCE PERMITTED ON CERTAIN INFORMATION.**

4.1 Geotechnical Data. By submitting a Proposal, Proposer represents and agrees that in submitting its Proposal, it is not relying on any geotechnical data supplied by District, except as specifically set forth herein.

4.2 The Proposer may rely upon the accuracy of the "technical data" contained in the geotechnical reports and drawings identified above, but only insofar as it relates to subsurface conditions and only if Proposer has conducted a thorough review of such technical data and discrepancies were not apparent. The term "technical data" in the referenced reports and drawings shall be limited as follows:

4.2.1 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.

4.2.2 The term "technical data" does not include, and the Proposer 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.

4.2.3 The term "technical data" shall not include the location of Underground Facilities.

4.2.4 The Proposer may not rely on the completeness of reports and drawings for design or construction. The Proposer may rely upon the general accuracy of the "technical data" contained in such reports or drawings.

4.2.5 The Proposer is responsible for making reasonable interpretations of technical data and reports. The Proposer is solely responsible for any unreasonable interpretation or conclusion drawn from any "technical data" or any other data, interpretations, opinions or information contained in supplied geotechnical data. However, compensation for unknown differing site conditions shall be allowed as is provided for in the Contract Documents.

5. **INVESTIGATIONS.**

5.1 Before submitting a Proposal, each Proposer shall conduct its own visual inspection of the Site and will be responsible for performing its own Geotechnical Investigation and report all other investigations that Proposer deems are necessary to make its Proposal and for performing and furnishing Work in accordance with the time, price and other terms and conditions of the Contract Documents. Proposer may rely upon the geotechnical and existing conditions data provided by the District only to the extent the Proposer's geotechnical engineer deems appropriate in the exercise of its professional judgment. The design shall not be developed based solely upon the information provided by the District.

Each Proposer will be responsible for obtaining and reviewing such 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, as deemed necessary by its geotechnical engineer, that may affect structural design, 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 the Proposer and safety precautions and programs incident thereto, and for performing reasonable on-site inspections for visible conditions, which the Proposer deems necessary to make its Bid and for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

Each Proposer shall conduct its own Hazardous Material Survey the Proposer deems necessary for the performance of its work.

6. **ACCESS TO SITE**.

6.1 Subject to District approval and reasonable scheduling, District will provide each Proposer access to the Site to conduct such examinations and investigations as each Proposer deems necessary for submission of its Proposal.

7. Section 01 88 20 (Miscellaneous Hazardous Materials Performance Requirements) describes hazardous material information included with the Request for Proposal Documents and use of data therein.

8. **REPORTS AND INFORMATION.**

8.1 The District, its consultants, Contractors, and agents have prepared and are preparing documents providing a general description of the Project Site and identifying locations of known or suspected hazardous materials. The existing documents consist of surveys included in the Project Manual. Additional documents may be provided to Proposers in an Addendum.

8.2 The Project Site consists of the following:

The Work generally consists of two primary phases:

Phase 1: Demolition of the existing office building at 2118 Milvia Street, Berkeley, CA 94704 originally constructed in 1966. Work includes the demolition of entire building, disposal of all existing building components down to and including slab, foundations, 12" of pier caps and site features including, but not limited to all existing utilities, gas meters, storm and sewer drainage, paving, trees and stumps, fencing, etc. within the designated scope of work boundaries.

The work also to include the abatement and removal of all asbestos containing material, lead base paint removal and pcb ballast removal in entire structure.

Phase 2: Completion of underground demolition and construction a new, 6-story classroom and administration building under DSA jurisdiction. The new building will be comprised primarily of general use classrooms, art and anthropology classrooms, faculty and administrative offices, a Learning Resource Center, Student Services & Learning Communities, student lounge, wellness clinic, rooftop patio, and building services for Berkeley City College.

9. **USE OF DATA**

9.1 Data regarding the locations and types of hazardous materials was obtained for use of District and its consultants, Contractors, agents, and tenants for planning and design and are not part of the Contract Documents. Proposer may rely on this information for its accuracy regarding the locations of potentially hazardous materials related to the Work. The provisions of Section 4 (Limited Reliance Permitted on Certain Information) apply to any hazardous materials information. Compensation to the Design Builder for unknown differing site conditions, including conditions that differ materially from those indicated in the reports or surveys referred to herein, shall be allowed as provided in the Contract Documents.

9.2 District does not warrant and makes no representation regarding the accuracy, completeness or thoroughness of any information verifiable by visual inspection. By submitting a Proposal, Proposer represents and agrees that in submitting a Proposal it has reviewed the data regarding existing conditions supplied by District concerning the general location of potentially hazardous materials.

10. **INVESTIGATIONS.**

10.1 Before submitting a Proposal, each Proposer shall conduct its own visual inspection of the Site, and with the District's consent, shall perform other investigations that Proposer deems are necessary to make its Proposal and for performing and furnishing Work in accordance with the time, price and other terms and conditions of the Contract Documents.

END OF DOCUMENT

LABOR COMPLIANCE PROGRAM

SECTION I
PUBLIC WORKS SUBJECT TO PREVAILING WAGE LAWS

State prevailing wage rates apply to all public works contracts as set forth in Labor Code Sections 1720 *et seq*., and include, but are not limited to, such types of work as construction, alteration, demolition, repair, or maintenance work. The Division of Labor Statistics and Research (DLSR) predetermines the appropriate prevailing wage rates for particular construction trades and crafts by county.

1 A. Types of Contracts to Which Prevailing Wage Requirements Apply

As provided in California Labor Code sections 17250.30(d)(2) and (d)(3), the regulations adopted by the Department of Industrial Relations pursuant to subdivision (g) of Section 1771.5 of the Labor Code apply such that the District shall reimburse the department for its reasonable and directly related costs of performing prevailing wage monitoring and enforcement on public works projects pursuant to rates established by the department as set forth in subdivision (h) of Section 1771,5 of the Labor Code. In lieu of reimbursing the Department of Industrial Relations for its reasonable and directly related costs of performing, monitoring, and enforcement on public works projects, the District will continue operating its existing previously approved labor compliance program to monitor and enforce prevailing wage requirements on this project because the District entered into a collective bargaining agreement that binds all of the contractors performing work on the project and that includes a mechanism for resolving disputes about the payment of wages.

SECTION II
JOB START MEETING

After the District awards the contract, and prior to the commencement of the work, a Job Start meeting (Pre-Job conference) may be conducted by the Labor Compliance Officer (LCO) with the contractor and those subcontractors listed in its bid documents.

At that meeting, the LCO will discuss the federal and state labor law requirements applicable to the contract, including prevailing wage requirements, the respective record keeping responsibilities, the requirement for the submittal of certified payroll records to the District, and the prohibition against discrimination in employment.

The LCO will provide the contractor and each subcontractor with a Checklist of Labor Law Requirements and will discuss in detail the following checklist items:

1. The contractor’s duty to pay prevailing wages (Labor Code Section 1770 et seq.);

2. The contractor’s duty to employ registered apprentices (Labor Code Section 1777.5);

3. The penalties for failure to pay prevailing wages and to employ apprentices, including forfeitures and debarment (Labor Code Sections 1775, 1777.7, and 1813);

4. The requirement to maintain and submit copies of certified payroll records to the District, on a weekly basis, as required (Labor Code Section 1776), and penalties for failure to do so (Labor Code Section 1776(g)); the requirement includes and applies to all subcontractors performing work on the project even if their portion of the work is less than one-half of one percent (1/2 of 1%) of the total amount of the contract.

5. The prohibition against employment discrimination (Labor Code Sections 1735 and 1777.6; the Government Code; and Title VII of the Civil Rights Act of 1964, as amended);

6. The prohibition against taking or receiving a portion of an employee's wages (Labor Code Section 1778) (kickback);

7. The prohibition against accepting fees for registering any person for public works (Labor Code Section 1779) or for filing work orders on public works (Labor Code Section 1780);

8. The requirement to list all subcontractors that are performing one-half of one percent of the total amount of the contract (Public Contract Code Section 4100 et seq.);

9. The requirement to be properly licensed and to require all subcontractors to be properly licensed, and the penalty for employing workers while unlicensed (Labor Code Section 1021 and under California Contractors License Law, also, see Business and Professions Code Section 7000, et seq.);

10. The prohibition against unfair competition (Business and Professions Code Sections 17200-17208);

11. The requirement that the contractor and subcontractor be properly insured for Workers' Compensation (Labor Code Section 1861); and

12. The requirement that the contractor abide by the Occupational Safety and Health laws along with all regulations that apply to the project.

It will be the DBE's responsibility to provide copies of the LCP package to all listed subcontractors and to any substituted subcontractors.

SECTION III
REVIEW OF CERTIFIED PAYROLL RECORDS

A. Certified Payroll Records Required

The DBE and each subcontractor shall maintain payrolls and basic records (timecards, canceled checks, cash receipts, trust fund forms, accounting ledgers, tax forms, superintendent and foreman daily logs, etc.) during the course of the work and shall preserve them for a period of three (3) years thereafter for all trades workers working on the project. Such records shall include the name, address, and social security number of each worker, his or her classification, a general description of the work each employee performed each day,

the rate of pay (including rates of contributions for, or costs assumed to provide fringe benefits), daily and weekly number of hours worked, and actual wages paid.

1. Submittal of Certified Payroll Records

   The DBE and each subcontractor shall maintain weekly certified payroll records for submittal to the Peralta Community College District LCO as required. The DBE shall be responsible for the submittal of payroll records of all its subcontractors. All certified payroll records shall be accompanied by a statement of compliance signed by the DBE or each subcontractor indicating that the payroll records are correct and complete, that the wage rates contained therein are not less than those determined by the Director of the Department of Industrial Relations, and that the classifications set forth for each employee conform with the work performed.

   Time cards, front and back copies of cancelled checks, daily logs, employee sign-in sheets and/or any other record maintained for the purposes of reporting payroll may be requested by the Labor Compliance Officer at any time and shall be provided within 10 days following the receipt of the request.

2. Full Accountability

   Each individual, laborer or craftsperson working on the project must appear on the payroll. The basic concept is that the employer who pays the trades worker must report that individual on its payroll. This includes individuals working as apprentices in an apprenticeable trade. Owner-operators are to be reported by the contractor employing them, rental equipment operators are to be reported by the rental company paying the workers' wages.

   Sole owners and partners who work on a contract must also submit a certified payroll record listing the days and hours worked, and the trade classification descriptive of the work actually done.

   The DBE shall provide the records required under this section to the District within five (5) days of each payday, and make them available for inspection by the Department of Industrial Relations, and shall permit representatives of each to interview trades workers during working hours on the project site.

3. Responsibility for Subcontractors

   DBE shall be responsible for ensuring adherence to labor standards provisions by its subcontractors. Moreover, DBE is responsible for Labor Code violations of its subcontractors in accordance with Labor Code section 1775.

4. Payment to Employees

   Employees must be paid unconditionally, and not less often than once each week, the full amounts, that are due and payable for the period covered by the particular payday. Thus, an employer must establish a fixed workweek (Sunday through Saturday, for example) and an established payday (such as every Friday or the preceding day should such

payday fall on a holiday). On each and every payday, each worker must be paid all sums due as of the end of the preceding workweek and must be provided with an itemized wage statement.

If an individual is called a subcontractor, whereas, in fact, he/she is merely a journey level mechanic supplying only his/her labor, such an individual would not be deemed a bona fide subcontractor and must be reported on the payroll of the DBE as a trades worker. Moreover, any person who does not hold a valid contractor's license cannot be a subcontractor, and anyone hired by that person is the worker or employee of the general contractor for purposes of prevailing wage requirements, certified payroll reporting and workers' compensation laws.

The worker's rate for straight time hours must equal or exceed the rate specified in the contract by reference to the "Prevailing Wage Determinations" for the class of work actually performed. Any work performed on Saturday, Sunday, and/or on a holiday, or portion thereof, must be paid the prevailing rate established for those days regardless of the fixed workweek. The hourly rate for hours worked in excess of 8 hours in a day and 40 hours in a workweek shall be premium pay. All work performed on Saturday, Sunday and holidays shall be paid pursuant to the Prevailing Wage determination.

B. Apprentices

Apprentices shall be permitted to work as such only when they are registered, individually, under a bona fide apprenticeship program registered and approved by the State Division of Apprenticeship Standards. The allowable ratio of apprentices to journeypersons in any craft/classification shall not be greater than the ratio permitted to the DBE as to its entire workforce under the registered program.

Any worker listed on a payroll at an apprentice wage rate who is not registered shall be paid the journey level wage rate determined by the Department of Industrial Relations for the classification of the work he/she actually performed. Pre-apprentice trainees, trainees in non-apprenticeable crafts, and others who are not duly registered will not be permitted on the project unless they are paid full prevailing wage rates as journeypersons.

Compliance with California Labor Code Section 1777.5 requires all public works contractors and subcontractors to:

1. Submit contract award information to the apprenticeship committee for each apprenticeable craft or trade in the area of the Project;

2. Request dispatch of apprentices from the applicable Apprenticeship Program(s) and employ apprentices on public works projects in a ratio to journeypersons which in no case shall be less than one (1) hour of apprentice work to each five (5) hours of journeyperson work; and

3. Contribute to the applicable Apprenticeship Program(s) or the California Apprenticeship Council in the amount identified in the prevailing wage rate publication for journeypersons and apprentices. If payments are not made to an Apprenticeship Program, they shall be

made to the California Apprenticeship Council, Post Office Box 420603, San Francisco, CA 94142.

If the DBE is registered to train apprentices, it shall furnish written evidence of the registration (i.e., Apprenticeship Agreement or Statement of Registration) of its training program and apprentices, as well as the ratios allowed and the wage rates required to be paid thereunder for the area of construction, prior to using any apprentices in the contract work. It should be noted that a prior approval for a separate project does not confirm approval to train on any project. The DBE/subcontractor must check with the applicable Joint Apprenticeship Committee to verify status.

C. Audit of Certified Payroll Records

Audits shall be conducted by the LCO, and shall also be conducted at the request of the Labor Commissioner to determine whether all trades workers on project sites have been paid according to the prevailing wage rates.

END OF SECTION

KNOW ALL PERSONS BY THESE PRESENTS:

WHEREAS, the governing board ("Board") of the Peralta Community College District ("District") and [Design/Builder] ("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:

[Name Of] Project

("Project" or "Contract") which Contract dated _____, 2020, 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 their 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 his or 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

Design/Builder 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

PERFORMANCE BOND
(100% of Contract Price)

KNOW ALL PERSONS BY THESE PRESENTS:

WHEREAS, the governing board ("Board") of the Peralta Community College District ("District") and [Design/Builder] ("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:

[Name Of] Project

("Project" or "Contract") which Contract dated _____, 2020, 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 warrantees 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 Design/Builder 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 Design/Builder remains. Nothing herein shall limit the District's rights or the

Design/Builder's 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

Design/Builder 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

REGISTERED SUBCONTRACTORS LIST
(Labor Code Section 1771.1)

PROJECT: [Name Of] Project

Date Submitted (for Updates): _____

Design/Builder 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 Design/Builder 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.

Design/Builder acknowledges and agrees that, if Design/Builder fails to list as to any subcontractor of any tier who performs any portion of Work, the Contract is subject is subject to cancellation and the Design/Builder 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: _____

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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 Design/Builder: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

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. Design/Builder 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 Design/Builder 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. Design/Builder'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 Design/Builder, its Subcontractors, suppliers, or anyone else for whom Design/Builder 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 Design/Builder'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 Design/Builder in writing, stating reasons. If the District and Design/Builder cannot agree on whether conditions justify an adjustment in Contract Price or Contract Time, or on the extent of any adjustment, Design/Builder shall proceed with the Work as directed by the District.

e. If after receipt of notice from the District, Design/Builder 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 Design/Builder stops Work in connection with any hazardous condition and in any area affected thereby, Design/Builder 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. Design/Builder 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. Design/Builder 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. Design/Builder 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. Design/Builder 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. Design/Builder 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 Design/Builder. In the event District elects to perform these activities and tests, Design/Builder 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. Design/Builder 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, Design/Builder may retain its own industrial hygiene consultant at Design/Builder’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 Design/Builder relating to the Work and Design/Builder shall immediately provide that documentation upon request.

5. Compliance with Laws

a. Design/Builder 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. Design/Builder 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. Design/Builder has the sole responsibility for determining current waste storage, handling, transportation, and disposal regulations for the job Site and for each waste disposal facility. Design/Builder 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. Design/Builder 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. Design/Builder 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. Design/Builder shall not use any disposal facility to which District has objected. Design/Builder 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, Design/Builder shall deliver all requisite notices and obtain the

approval of all governmental and quasi-governmental authorities having jurisdiction over the Work. Design/Builder 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, Design/Builder 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. Design/Builder shall not conduct any Work involving asbestos-containing materials or PCBs unless Design/Builder 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 Design/Builder. Design/Builder shall give all notices and comply with the all applicable laws bearing on the conduct of the Work as drawn and specified. If Design/Builder 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 Design/Builder 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 Design/Builder in securing the permit or giving the notice, but the Design/Builder 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. § 960l *et seq*.).

9. Termination

District shall have an absolute right to terminate for default immediately without notice and without an opportunity to cure should Design/Builder 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 SECTION

Dated: _____

TO: [name of Design-Build Entity]
(Design-Build Entity)

ADDRESS: [address]

PROJECT: Berkeley City College - 2118 Milvia Street Project
PCCD Project No. 20-21/06

You are notified that the Contract Time under the above Contract will commence to run on _____, 2021, for the Berkeley City College – 2118 Milvia Street Project. By that date, you are to start performing your design obligations under the Contract Documents. In accordance with Paragraph 3.1 of Document 00 50 00 Agreement, the date of Substantial Completion of is _____, 2024, the date of Final Completion is _____, 2024.

Before you may start any Work at the site, you must:

_____

_____

PERALTA COMMUNITY COLLEGE DISTRICT

By:_____
[Name of Project Manager]
Project Manager

END OF SECTION

Dated: _____

TO: [name of Design-Build Entity]
(Design-Build Entity)

ADDRESS: [address]

PROJECT: Berkeley City College – 2118 Milvia Street Project
PCCD Project No. 20-21/06

You are hereby authorized to start performing your construction obligations under the Contract Documents. In accordance with Paragraph 3.1 of Document 00 50 00 Form of Agreement, the date of Substantial Completion of [description of project increment] is _____, 20XX, the date of Final Completion is _____, 20XX.

Before you may start any Work at the site, you must:

_____

_____

_____

_____

PERALTA COMMUNITY COLLEGE DISTRICT

By:_____
[Name of Project Manager]
Project Manager

END OF DOCUMENT

NOTICE OF AWARD

Dated _____

TO: _____

ADDRESS: _____

_____

CONTRACT FOR:

PCCD Project No. 20-21/06
2118 Milvia Street Project – Berkeley City College

The Contract Sum of your contract is _____ Dollars ($_____).

1. DBE shall provide the District with one (1) electronic copy of the DB documents.

2. You must comply with the following conditions by 2:00 p.m. on [___day_____], [____date____].
   a. Deliver to District two fully executed counterparts of Section 00 50 00 (Form of Agreement).
   b. Deliver to District one (1) original set of the insurance certificates with endorsements required under Article 15 of Section 00 50 00 (Agreement), along with one (1) original copy of the SEWUP Contract Enrollment Form for OCIP.
   c. Project Labor Agreement (PLA): Agreed to Letter of Assent as set forth in Appendix D (Project Labor Agreement) in Section 00 50 00 (Form of Agreement). Submit one original.

3. 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.

4. Within ten (10) Days after you comply with the conditions in paragraph 2 of this Section 00 51 03, District will return to you one fully executed copy of Section 00 50 00 (Form of Agreement) from the Contract Documents.

5. Upon commencement of the Work, you and each of your Subcontractors shall certify and make available for inspection payroll records on forms provided by the Division of Labor Standards Enforcement, in accordance with Section 1776 of the California Labor Code.

6. Send all of the required above listed items to:

Peralta Community College District
Attn: John Hiebert / Purchasing Buyer
333 East 8th Street, Oakland, CA 94606

PERALTA COMMUNITY COLLEGE DISTRICT ("District")

BY: _____
John Hiebert – District Purchasing Buyer

END OF DOCUMENT

NOTICE OF INTENT TO AWARD DESIGN-BUILD CONTRACT

DATE POSTED: [insert date

PROJECT NUMBER: 20-21/06

PROJECT TITLE: BERKELEY CITY COLLEGE – 2118 MILVIA STREET PROJECT

Atheria Smith, the Executive Bonds Manager of the Peralta Community College District, intends to recommend to the Board of Trustees of the Peralta Community College District on [Month Day, Year] the award of the above-referenced Project to [Name of Design-build Entity].

If approved, a formal Notice of Award will be issued.

SIGNATURE _____ DATE _____

[_____],
[Name]
[_____]
[Title]

END OF DOCUMENT

PART 1 – GENERAL

1. Requirement to Escrow Bid Documentation

   a. Design Builder shall submit, within seven (7) days after the date of the Notice of Award, one copy of all documentary information received or generated by Design Builder 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 Design Builder will be held in escrow for the duration of the Contract.

   b. Design Builder 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. Design Builder 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. Design Builder'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 Design Builder fail to make the submission within the allowed time specified above, District may deem the Design Builder to have failed to enter into the Contract, and the Design Builder shall forfeit the amount of its bid security, accompanying the Design Builder's bid, and District may award the Contract to the next most advantageous proposal.

   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 Design Builder to the District.

2. Ownership of Escrow Bid Documentation

   a. The Escrow Bid Documentation is, and shall always remain, the property of Design Builder, subject to review by District, as provided herein.

   b. Escrow Bid Documentation constitute trade secrets, not known outside Design Builder's business, known only to a limited extent and only by a limited number of employees of Design Builder, safeguarded while in Design Builder's possession, extremely valuable to Design Builder, and could be extremely valuable to Design Builder's competitors by virtue of it reflecting Design Builder'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. Design Builder 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 English.

   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 Design Builder to arrive at the prices contained in the bid proposal. Estimated costs should be broken down into Design Builder'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 Design Builder's usual format. The Design Builder'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 Design Builder in a sealed container within seven (7) days after the date of the Notice of Award. The container shall be clearly marked on the outside with the Design Builder'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 Design Builder".

   b. By submitting Escrow Bid Documentation, Design Builder represents that the material in the Escrow Bid Documentation constitutes all of the documentary information used in preparation of the bid and that the Design Builder has personally examined the contents of the Escrow Bid Documentation container and has found that the documents in the container are complete.

   c. If Design Builder'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 Design Builder, shall provide separate Escrow Documents to be included with those of Design Builder. Those documents shall be opened and examined in the same manner and at the same time as the examination described above for Design Builder.

   d. If Design Builder wishes to subcontract any portion of the Work after award, District retains the right to require Design Builder 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 Design Builder for the duration of the project until final Contract payment. The storage facilities shall be the appropriate size for all of the Escrow Bid Documentation and located conveniently to both District's and Design Builder's offices.

   b. The Escrow Bid Documentation shall be examined by both District and Design Builder, at any time deemed necessary by either District or Design Builder, 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 Design Builder.

      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 Design Builder shall each designate, in writing to the other party seven (7) 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 both District and Design Builder. If Design Builder fails to designate a representative or appear for joint examination on seven (7) days notice, then the District representative may examine the Escrow Bid Documentation alone upon an additional three (3) days notice if a representative of Design Builder does not appear at the time set.

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

END OF SECTION

PART 1 – GENERAL

1. Requirement to Escrow Bid Documentation

   a. Design Builder shall submit, within seven (7) days after the date of the Notice of Award, one copy of all documentary information received or generated by Design Builder 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 Design Builder will be held in escrow for the duration of the Contract.

   b. Design Builder 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. Design Builder 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. Design Builder'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 Design Builder fail to make the submission within the allowed time specified above, District may deem the Design Builder to have failed to enter into the Contract, and the Design Builder shall forfeit the amount of its bid security, accompanying the Design Builder's bid, and District may award the Contract to the next most advantageous proposal.

   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 Design Builder to the District.

2. Ownership of Escrow Bid Documentation

   a. The Escrow Bid Documentation is, and shall always remain, the property of Design Builder, subject to review by District, as provided herein.

   b. Escrow Bid Documentation constitute trade secrets, not known outside Design Builder's business, known only to a limited extent and only by a limited number of employees of Design Builder, safeguarded while in Design Builder's possession, extremely valuable to Design Builder, and could be extremely valuable to Design Builder's competitors by virtue of it reflecting Design Builder'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. Design Builder 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 English.

   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 Design Builder to arrive at the prices contained in the bid proposal. Estimated costs should be broken down into Design Builder'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 Design Builder's usual format. The Design Builder'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 Design Builder in a sealed container within seven (7) days after the date of the Notice of Award. The container shall be clearly marked on the outside with the Design Builder'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 Design Builder".

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   c. If Design Builder'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 Design Builder, shall provide separate Escrow Documents to be included with those of Design Builder. Those documents shall be opened and examined in the same manner and at the same time as the examination described above for Design Builder.

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   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 Design Builder for the duration of the project until final Contract payment. The storage facilities shall be the appropriate size for all of the Escrow Bid Documentation and located conveniently to both District's and Design Builder's offices.

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

END OF SECTION

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. (Public Resources Code section 21000 *et seq*.)

2. Modernization Projects

2.27 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.

2.28 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.

2.29 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.

2.30 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.

2.31 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.

2.32 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.

2.33 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.

3.27 Badges must be filled out in full and contain the following information:

3.27.1 Name of Contractor

3.27.2 Name of Employee

3.27.3 Contractor's address and phone number

3.28 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.

3.29 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. Substitution for Specified Items

4.27 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.

4.27.1 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.

4.27.2 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.

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

4.28.1 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.

4.28.2 Requests for Substitutions after award of the Contract shall be submitted within thirty-five (35) days of the date of the Notice of Award (for work included in RFP), within thirty-five (35) days of the date of receipt of bids for individual trade packages.

4.29 Accompanying substitution request, Contractor shall provide data substantiating a request for substitution of “an equal” item, including but not limited to the following:

4.29.1 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;

4.29.2 Available maintenance, repair or replacement services;

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

4.29.4 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

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

4.30 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:

4.30.1 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;

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

4.30.3 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;

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

4.30.5 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.

4.31 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.

4.32 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.

4.33 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

Delays due to Adverse Weather conditions will only be permitted in compliance with the provisions in the General Conditions and only if the number of days of Adverse Weather exceeds the following parameters and Contractor can verify that the excess days of Adverse Weather caused delays:

January	5	July	2
February	5	August	2
March	5	September	3
April	4	October	3
May	3	November	4
June	2	December	5

6. Insurance Policy Limits

All of Contractor's insurance shall be with insurance companies with an A.M. Best rating of no less than ___TBD_____. The limits of insurance shall not be less than:

Commercial General Liability	Product Liability and Completed Operations, Fire Damage Liability – Split Limit	[E.G. Low Risk: $1,000,000 per occurrence; $2,000,000 aggregate
		Intermediate Risk: $2,000,000 per occurrence; $4,000,000 aggregate
		High Risk: $5,000,000 per occurrence; $10,000,000 aggregate]

Automobile Liability – Any Auto	Combined Single Limit	[E.G. Personal vehicles: $500,000 Commercial vehicles: $2,000,000
		Personal vehicles: $100,000 per person/ $300,000 per accident]
Workers' Compensation		Statutory limits pursuant to State law
Employers' Liability		[E.G. $5M]
Builder's Risk (Course of Construction)		Replacement Cost
Pollution Liability		[E.G. $1M per claim; $2M aggregate]

7. Permits, Certificates, Licenses, Fees, Approvals

7.27 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:

7.27.1 DSA permit fees

With respect to the above-listed items, Contractor shall be responsible for securing such items; however, District will be responsible for payment of these charges or fees. Contractor shall notify the District of the amount due with respect to such items and to whom the amount is payable. Contractor shall provide the District with an invoice and receipt with respect to such charges or fees.

7.28 General Permit For Storm Water Discharges Associated With Construction and Land Disturbance Activities

7.28.1 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):

7.28.1.1 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:

7.28.1.1.1 Comply with lawfully enacted stormwater management and/or erosion control ordinance.

7.28.1.1.2 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").

7.28.1.1.2.1 Soil loss BMP's that should be considered for implementation as appropriate for each project include, but are not limited to, the following:

7.28.1.1.2.1.1 Scheduling construction activity during dry weather, when possible.

7.28.1.1.2.1.2 Preservation of natural features, vegetation, soil, and buffers around surface waters.

7.28.1.1.2.1.3 Drainage swales or lined ditches to control stormwater flow.

7.28.1.1.2.1.4 Mulching or hydroseeding to stabilize disturbed soils.

7.28.1.1.2.1.5 Erosion control to protect slopes.

7.28.1.1.2.1.6 Protection of storm drain inlets (gravel bags or catch basin inserts).

7.28.1.1.2.1.7 Perimeter sediment control (perimeter silt fence, fiber rolls).

7.28.1.1.2.1.8 Sediment trap or sediment basin to retain sediment on site.

7.28.1.1.2.1.9 Stabilized construction exits.

7.28.1.1.2.1.10 Wind erosion control.

7.28.1.1.2.1.11 Other soil loss BMP's acceptable to the enforcing agency.

7.28.1.1.2.2 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:

7.28.1.1.2.2.1 Dewatering activities.

7.28.1.1.2.2.2 Material handling and waste management.

7.28.1.1.2.2.3 Building materials stockpile management.

7.28.1.1.2.2.4 Management of washout areas (concrete, paints, stucco, etc.).

7.28.1.1.2.2.5 Control of vehicle/equipment fueling to contractor's staging area.

7.28.1.1.2.2.6 Vehicle and equipment cleaning performed off site.

7.28.1.1.2.2.7 Spill prevention and control.

7.28.1.1.2.2.8 Other housekeeping BMP's acceptable to the enforcing agency.

7.28.1.2 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.

7.28.2 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.

7.28.3 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:

7.28.3.1 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

7.28.3.2 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

9.27 Contractor shall submit Record Drawings pursuant to the Contract Documents consisting of one set of computer-aided design and drafting ("CADD") files plus one set of record Drawings

10. Disabled Veteran Business Enterprise

Pursuant to Education Code section 71028 and Public Contract Code section 10115, the District has a participation goal for disabled veteran business enterprises ("DVBE") of at least three percent (3%) per year of the overall dollar amount expended each year on District projects. Therefore, the lowest responsive responsible bidder awarded the Contract must submit the Disabled Veteran Business Enterprise Participation Certification to the District with its executed Agreement, identifying the steps contractor took to solicit DVBE participation in conjunction with this Contract.

11. Construction Manager

The District will use a Construction Manager on the Project that is the subject of this Contract. Swinerton Management Company is the Construction Manager for this Project.

12. Program Manager

AECOM is the Program Manager designated for the Project that is the subject of this contract.

13. 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.

13.27.1

END OF SECTION

1.1 GENERAL:

1.1.1 The following additional requirements apply to this Project that is being reviewed by the Division of the State Architect (DSA).

1.2 ADDITIONAL REQUIREMENTS:

1.2.1 In addition to the duties specified in the Contract Documents, the duties of the Design Builder shall be in accordance with the requirements specified in Title 24 of the California Code of Regulations (CCR).

1.2.2 In addition to the duties specified in the Contract Documents, the duties of the Architect and the Architect's consultants shall be in accordance with the requirements specified in Part 1, Title 24, CCR.

1.2.3 DSA is not subject to arbitration proceedings.

1.2.4 Notify DSA at start of construction in accordance in Part 1, Title 24, CCR.

1.2.5 Design Builder shall submit 100 % Construction Documents to DSA for approval.

1.2.6 Design Builder shall schedule a Presubmittal meeting with DSA and the Design Build Team to obtain specific requirements from DSA for submittal of construction documents and to make DSA aware of the scheduled submittal date.

1.2.7 If and when applicable, addenda and change orders shall be submitted to and approved by DSA. Do not begin any work under an addendum or change order until such applicable DSA approval is obtained. Addenda and change orders shall be in accordance in Part 1, Title 24, CCR.

1.2.8 If and when applicable, do not begin work under a written order until a change order has been submitted to and approved by DSA in accordance with Part 1, Title 24, CCR. Substitutions effecting structural, fire/life/safety or access compliance shall be submitted as change orders for DSA approval. The Design Builder will be responsible for the additional architectural and engineering costs associated with the review and regulatory processing of these substitutions.

1.2.9 Unless otherwise indicated or specified, perform the work in conformance with the latest edition of applicable regulatory requirements. A copy of Part 1 and Part 2 of Title 24, CCR shall be available on the Project site. If and when applicable, the codes adopted by the City, County, State and Federal agencies shall govern minimum requirements for this Project.

1.2.10 Design Builder shall submit verified reports in accordance with Part 1, Title 24, CCR.

1.2.11 DSA may supervise construction, reconstruction, or repair in accordance with Part 1, Title 24, CCR.

1.2.12 Construction shall be observed by a full-time Project Inspector approved by DSA in accordance with Part 1, Title 24, CCR.

1.2.13 Testing requirements of the District's Testing Laboratory shall be in accordance with Part 1,Title 24, CCR.

1.2.14 Special Inspection on masonry construction, glued laminated lumber, wood framing using timber connectors, ready-mixed concrete, gunite, pre-stressed concrete, high strength steel bolt installation, welding, pile driving, and mechanical and electrical work shall be as required by Part 1,Title 24, CCR. The costs of special inspection will be paid for by the District.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL:

1.1.1 The following additional requirements apply to this Project that is being reviewed by the Division of the State Architect (DSA).

1.2 ADDITIONAL REQUIREMENTS:

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1.2.7 If and when applicable, addenda and change orders shall be submitted to and approved by DSA. Do not begin any work under an addendum or change order until such applicable DSA approval is obtained. Addenda and change orders shall be in accordance in Part 1, Title 24, CCR.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

This Section includes summary of work including:

1.1.1 Work covered by Contract Documents
1.1.2 Work under other contracts
1.1.3 Future work
1.1.4 Work sequence
1.1.5 Cooperation of Design Builder and coordination with other work
1.1.6 Maintenance
1.1.7 Occupancy requirements
1.1.8 Reference Standards
1.1.9 Products or services ordered in advance
1.1.10 District furnished products
1.1.11 Execution

1.2 WORK COVERED BY CONTRACT DOCUMENTS

1.2.1 The work includes to construct the 2118 Milvia Street Project at Berkeley City College for the Peralta Community College District.

1.2.2 The DBE will ensure adequate protection of the facility and vehicular and pedestrian traffic at all times.

1.2.3 The Contract requires Design Builder to commission and turn over the 2118 Milvia Street Project to District as a completed project in accordance with the terms and conditions of the Contract Documents. The Project is more fully described in the Criteria Documents included with this Project Manual and the Design Builder's Proposal.

1.2.4 Unless provided otherwise in the Contract Documents, all risk of loss to Work covered by the Contract Documents shall rest with Design Builder until Final Completion and Acceptance of the Work by the District or termination of the Design-Build Contract, whichever occurs first.

1.3 WORK UNDER OTHER CONTRACTS

1.3.1 DBE to provide Geotechnical Engineering report.

1.3.2 DBE to provide testing for hazardous materials.

1.4 FUTURE WORK

1.4.1 Not Used.

1.5 WORK SEQUENCE

1.5.1 Not Used.

1.6 COOPERATION OF DESIGN BUILDER AND COORDINATION WITH OTHER WORK.

1.6.1 Should construction work, or work of any other nature, be underway by other forces or by other contractors within or adjacent to the limits of the Work at the time of executing the Contract, or should work be performed under the contracts listed in paragraphs 1.3 and 1.4 above, the Design Builder shall cooperate with all such other contractors or forces to the end that any delay or hindrance to their work will be avoided. The cost of such cooperation will be considered as included in the contract price and no additional payment will be made therefor. Design Builder shall coordinate with such other contractors and forces as required by Document 00 50 00 (Agreement).

1.6.2 District reserves the right to perform other or additional work, within or adjacent to the limits of the Work specified, at any time by the use of other forces. In the event that the performance of such other or additional work materially increases or decreases Design Builder's costs, the work and the amount to be paid therefor will be appropriately adjusted as determined by District.

1.6.3 Design Builder shall limit use of the Site for the Work and for construction operations to allow for:

1.6.3.1 District's operations
1.6.3.2 Work by other contractors

1.6.4 Design Builder shall coordinate use of and access to the Site with other contractors, utilities, and District's forces, as required by Document 00 50 00 (Agreement). District has final authority over coordination, use of premises, and access to the Site.

1.6.5 Design Builder shall cooperate with District and others who may occupy or begin work on Site and inside any building thereon prior to completion of Work of this Contract.

1.6.6 Design Builder shall cooperate with contractors for other area work, not included in Contract, but which may take place during construction period.

1.6.7 Design Builder, and all design consultants and major subcontractors shall participate in partnering sessions as described in Section 00 50 00 (Agreement).

1.7 MAINTENANCE

1.7.1 Cost of maintenance of systems and equipment prior to Substantial Completion, as defined in section 00 50 00 (Form of Agreement), is included in the Contract Price and no additional payment will be made therefor.

1.8 OCCUPANCY REQUIREMENTS

1.8.1 Whenever, in the opinion of District, Work or any part thereof is in a condition suitable for use, and the best interest of District requires such use, District may take Beneficial Occupancy of and connect to, open for public use, or use the Work or such part thereof pursuant to paragraph 8.16.3 (Beneficial Occupancy) of paragraph 1.7 of section 00 50 00 (Agreement). In such case, District will inspect the Work or part thereof, and issue a Certificate of Beneficial Occupancy for that part of Work.

1.8.2 Prior to date of Final Acceptance of the Work by District, all necessary repairs or renewals in Work or part thereof so used, not due to ordinary wear and tear, but due to defective design, materials or workmanship or to operations of Design Builder, shall be made at expense of Design Builder, as required in section 00 50 00 (Agreement).

1.8.3 Use by District of Work or part thereof as contemplated by this Section shall in no case be construed as constituting acceptance of Work or any part thereof. Such use shall neither relieve Design Builder of any responsibilities under Contract, nor act as a waiver by District of any of the requirements thereof.

1.8.4 District may specify in the Contract Documents that portions of the Work, including electrical and mechanical systems or separate structures, shall be substantially completed on milestone dates prior to the Substantial Completion of all of the Work. Design Builder shall notify District in writing when Design Builder considers any such part of the Work ready for its intended use and substantially complete and request District to issue a Certificate of Substantial Completion for that part of the Work.

PART 2 - PRODUCTS

2.1 REFERENCE STANDARDS

2.1.1 For products specified by association or trade standards, comply with requirements of District standards, except where more rigid requirements are specified or are required by applicable codes.

2.2 PRODUCTS OR SERVICES ORDERED IN ADVANCE

2.2.1 District furnished products listed in paragraph 2.3 below will be procured under separate contracts and provided by District or vendor to Design Builder for installation under the terms of paragraph 1.6 above. Design Builder to provide utility service and stub out connections as necessary for the installation of District furnished products.

2.3 DISTRICT FURNISHED PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 Internet/Web-Based Project Management Software**.** The Design Builder is directed to use the project's existing Internet/Web-based project management software, to track and manage the project, as described in Section 01 31 20 Project Management Software.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

This Section includes a summary of the Work including:

1.1.1 Design Services
1.1.2 Proposal Phase
1.1.3 Design Confirmation Phase
1.1.4 Construction Documents Phase
1.1.5 Construction Phase
1.1.6 Operation/Project Close Out

1.2 DESIGN SERVICES

1.2.1 Summary of Design and Technical Requirements

1.2.1.1 The Criteria Documents set forth the District's minimum design and construction requirements for the Project that the Design Builder shall meet in preparing designs and constructing the Project. Design Builder shall prepare designs to meet these requirements and submit deliverables as described in these requirements. The requirements of this Section supplement but do not supersede the requirements of the Criteria Documents.

1.2.1.2 As required in this specification, Design Builder shall submit designs and deliverables meeting the requirements of the Contract Documents at the completion of the Collaboration Phase, 100% Schematic Design, 100% Design Development, 50% Construction Documents and 100% Construction Documents. DBE shall obtain District approval at each milestone prior to continuing with design. Design Builder may elect to create incremental packages of major building components or activities it deems advantageous towards scheduling or permitting efficiencies.

1.2.1.3 Unless specifically and expressly limited, Design Builder's scope of work shall include all engineering, procurement and construction necessary to complete the Project.

1.2.2 Summary of Work

1.2.2.1 Unless specifically excluded from this Contract, Design Builder shall provide to District all professional architectural, engineering services and other specialty consultants as necessary to perform Design Builder's obligations under the Contract Documents and to complete the Project including, but not limited to, the requirements of the Criteria Documents, as modified, if at all, pursuant to section 00 50 00 (For of Agreement) (the "Services").

1.2.2.2 Design Builder shall perform the Services using the persons and subconsultants listed in Design Builder's Pre-Qualification Questionnaire and Proposal and may substitute personnel or subconsultants only upon the District's written consent, which is in District's discretion but will not be unreasonably withheld. Design Builder represents that it and its subconsultants possess all necessary training, qualifications, licenses and permits to perform the Services, and that their performance of the Services will conform to the standard of practice of a professional that specializes in performing professional services of like nature and complexity of the Services. Design Builder's licensed subconsultants (architectural, engineering and other specialty consultants) shall owe a duty of care to the District in performing their architectural and engineering portions of the Services.

1.2.2.3 Design Builder and its subconsultants shall make an independent assessment of the accuracy of the information provided by the District concerning existing conditions (including but not limited to existing utilities and structures and tie-ins to existing or contemplated facilities) and the adequacy of available design information/technical reports. Design Builder shall rely on the results of its own independent investigations and not on information provided by District. Design Builder shall conduct such further investigations of existing conditions as are necessary for Design Builder to perform the Services and shall advise District of any further design or other services necessary to complete the Project.

1.2.2.4 Design Builder's design shall provide that all surfaces, fixtures and equipment are readily accessible for maintenance, repair or replacement by ladders, power lifts, cat walks, and the like without exceeding the design loads of the floors, roofs, ceilings, and that such access is in conformance with Cal OSHA. All drawings, shop drawings and specifications in the Construction Documents, structural, electrical and other design calculations, site data, and any other deliverable required by State or Federal law shall comply with State and Federal standards. Design Builder shall comply with any other requirements of public or private authorities with jurisdiction over the Project, the Construction Documents, or tie-ins to the Project. Design Builder shall comply with the applicable standard of care of a specialist when preparing Construction Documents to comply with applicable building codes, ordinances, statutes, laws, District standards, governmental regulations and private restrictions, including necessary tie-ins, applicable to the Project and the Services, including, but not limited to, those listed in this Contract, all environmental, energy conservation, energy tie-in, and disabled access requirements, regulations and standards of State and local Fire Marshals or other authorities having jurisdiction over the Project.

1.2.2.5 District at all times shall have the right (but not the duty) to review Design Builder's design work, whether performed by Design Builder or a subconsultant of any tier, and whether in a final or preliminary form,

to determine progress and conformance to the requirements of the Contract Documents. In the event the District should ever dispute the conformance of any design work (at any stage) with the intent of the Contract Documents, then the District's determination shall control and the Design Builder and/or its subconsultants shall perform the disputed design services and/or work to completion in accord with the District's determination. The Design Builder shall, however, retain its rights under the procedure of Article 13 of section 00 50 00 (Agreement) for disputes and claims, and Design Builder may under that procedure and in its name advance any claim of a subconsultant of any tier.

1.2.2.6 All work associated with the abatement of hazardous materials is the responsibility of the Design Builder. The Design Builder shall employ an industrial hygienist to perform and monitor the work. Refer to Section 01 88 20 (Miscellaneous Hazardous Materials Performance Requirements) for additional information.

1.2.2.7 All work associated with permanent signage and wayfinding is the responsibility of the Design Builder.

1.2.2.7.1 The Design Builder will work closely with the District and the District Standards to develop signage and wayfinding scope that meets the needs of the Project. The Wayfinding and Signage subconsultant shall address the following items while developing their design:

1.2.2.7.1.1 Changeability – Design must allow for the cost effective modification as the needs of the Project change over time. Signage should be specified so that the District can easily update signage on site.

1.2.2.7.1.2 Durability and Maintenance – Signage and wayfinding materials must be extremely durable and easily maintainable.

1.2.2.7.1.3 Coordination with other disciplines such as architecture, interior design, and lighting design to ensure a coordinated and integrated wayfinding design.

1.2.2.7.1.4 Readability and universal messages that intuitively meet the needs of the District.

1.2.2.7.1.5 Code Compliance.

1.2.2.7.1.6 Exterior and site wayfinding that identifies the Project, main entry, vehicular access,

pedestrian access, property boundaries, and directions on surrounding City streets.

1.2.2.7.1.7 Interior wayfinding that identifies the Project identity, department identification, room identification, and staff specific signage.

1.2.2.7.1.8 Enhanced environmental graphics that consider appropriate application of electronic media, interactive technologies, public artwork and architectural solutions to address wayfinding challenges.

1.2.2.7.2 The Design Builder will submit its design for signage and wayfinding to the District in accordance with the provisions of this Section.

1.2.2.8 Design Builder's Interior Design Services.

1.2.2.8.1 The Design Builder shall provide all Interior Design services for the Project.

1.2.3 Coordination of Architectural and Engineering Subconsultants/Other Contractors

1.2.3.1 Design Builder shall fully coordinate all architectural and engineering disciplines and subconsultants involved in completing the Work, including but not limited to, all subconsultants employed by Subcontractors or suppliers. Design Builder's subconsultants of all tiers shall fully coordinate with Design Builder and all architectural and engineering disciplines and subconsultants involved in completing the Work.

1.2.3.1.1 Design Builder shall require its subconsultants to agree in their subcontracts to coordinate with Design Builder and other subconsultants.

1.2.3.1.2 See Section 01 31 19 (Project Meetings) for minimum meeting requirements.

1.2.4 Project Master Schedule

1.2.4.1 Design Builder shall complete or cause to be completed all services required under this Agreement in accordance within Contract Time as defined in Article 9 of Section 00 50 00 (Form of Agreement) as well as all approved project schedules and updates thereto.

1.2.4.2 Design Builder shall provide District with a design and construction schedule that outlines dates and time periods for the delivery of Design Builder's services and requirements for information from the District for the performance of its services. The Project Master

Schedule will include activities for completing the project design documents (through release for construction), significant construction milestones, construction submittals and long lead item procurement, dates for decisions by District affecting schedule, and utility interruptions affecting Project operations. For more detailed information refer to Section 00 50 00 (Agreement).

1.2.4.3 The Project Master Schedule shall be updated monthly, and shall meet the following requirements:

1.2.4.3.1 The schedule shall fit within and coordinate with the Milestone Schedule in Exhibit B of Section 00 50 00 (Form of Agreement) including any and all design interfaces.

1.2.4.3.2 The schedule shall be in fully operational Primavera® (latest edition) computer software format.

1.2.4.4 Design Builder shall adjust and cause its retained subconsultants and Subcontractors to adjust activities, personnel levels, and the sequence, duration and relationship of services to be performed in a manner that will comply with the approved schedules.

1.2.4.5 Design Builder has no restraints on when it may bid or assign work to Subcontractors.

1.2.5 Deliverables Required Under This Agreement - General

All deliverables required under this Agreement shall be submitted in full compliance with the Contract Documents, shall be submitted in at least triplicate (or such greater number as the District may reasonably request) and, when contained on electronic media, shall be submitted in printed form as well as on electronic media when requested by the District. In the event of a conflict between the electronic version and hard copy versions of Design Builder's documents, the hard copy shall govern.
DBE shall provide interior and exterior color boards and materials for District approval. Final presentation shall include both interior and exterior elevations for approval.
Deficiencies in deliverables and modifications to conform to program requirements and modifications to achieve acceptability of deliverables to District, shall be promptly performed as part of the Stipulated Sum.

1.3 PROPOSAL & RECONCILIATION PHASE

1.3.1 Proposal Phase Documents

In response to the Request for Proposal the Design Builder shall submit Proposal Phase Documents as required by the Request for Proposal. Upon selection by PCCD, DBE shall work with the District to Reconcile and finalize scope of Work as specified in Section 00 26 40 (Rules and Procedures for Discussions and Negotiations).

1.4 DESIGN CONFIRMATION PHASE

1.4.1 Period of Service

1.4.1.1 After reconciliation of the Design Builder's Proposal, and upon written authorization from the District, Design Builder shall proceed with the performance of the services called for in the Collaboration Phase, as described in Section 00 50 00 (Form of Agreement). The intent of the Design Builder's Design Collaboration Phase is to obtain District approval for design revisions, refinements, and concept elaborations produced by the Design Builder prior to formal Design and Construction Document Production. Design Builder may elect to submit Collaboration Phase Documents incrementally by major building phases, components, or areas to facilitate economy of schedule provided overall design concept is clear and adhered to.

1.4.1.2 Design Builder shall submit deliverables required to execute and manage the Collaboration Phase including a revised detailed Cost Estimate with breakdown of all Project Costs.

1.4.1.3 Design Builder shall at the outset of this Phase make full written disclosure to District, and obtain District's express written approval of, any proposed innovative, unique, proprietary or sole source design features. District retains full discretion to disapprove such features.

1.5 DESIGN AND CONSTRUCTION DOCUMENTS PHASE

1.5.1 Period of Service

1.5.1.1 After acceptance by the District of the requirements of the Collaboration Phase, and upon written authorization from the District, Design Builder shall proceed with the performance of the services called for in the Design and Construction Document Phases.

1.5.1.2 Design Builder shall submit the deliverables required by these Phases, within the period approved and required in the Project Milestone Schedule.

1.5.2 Construction Documents Design Builder shall prepare final Construction Documents to show the work to be furnished and performed by Design Builder. The Construction Documents shall become a part of the Contract Documents. Construction Documents shall set forth in detail the requirement for construction of all work to be performed by Design Builder. Construction Documents shall not supersede the Contract Documents where the Contract Documents contain a more stringent requirement. Construction Documents shall consist of all site, architectural, structural, MEP and specialty design drawings, specifications, calculations and details to obtain all regulatory approvals and construct the project.

1.5.2.1 Architectural

1.5.2.1.1 Completed site plan.

1.5.2.1.2 Completed floor plans, elevations, and sections.

1.5.2.1.3 Architectural details and large blow-ups completed.

1.5.2.1.4 Finish, door, and hardware schedules completed, including all details.

1.5.2.1.5 Site utility plans completed.

1.5.2.1.6 Fixed equipment details and identification completed.

1.5.2.1.7 Reflected ceiling plans completed.

1.5.2.2 Structural

1.5.2.2.1 Structural floor plans and sections with detailing completed.

1.5.2.2.2 Structural calculations completed.

1.5.2.3 Mechanical

1.5.2.3.1 Large scale mechanical details completed including fire sprinkler system.

1.5.2.3.2 Mechanical schedules for equipment completed.

1.5.2.3.3 Completed mechanical schematic for environmental cooling and exhaust equipment.

1.5.2.3.4 Complete energy conservation calculations and report necessary for compliance with California Title 24 energy requirements.

1.5.2.4 Electrical

1.5.2.4.1 Lighting and power plan showing all switching and controls. Fixture schedule and lighting details completed.

1.5.2.4.2 Distribution information on power consuming equipment, including lighting, power, signal and communication device(s) branch wiring completed.

1.5.2.4.3 All electrical equipment schedules completed.

1.5.2.4.4 Low Voltage and special system component and distribution plans completed including Fire Alarm system.

1.5.2.4.5 Electrical load calculations completed.

1.5.2.5 Civil

1.5.2.5.1 All site plans, site utilities, parking and roadway systems completed.

1.5.3 Attend Required Meetings Attend meetings with community, representatives of the District and its designated consultants and appropriate governmental agencies and provide information and diagrams to fully describe the project.

1.5.4 Deliverables Contractor shall submit one (1) electronic copy of all milestone documents, including Collaboration, 100% SD, 100% DD, 50% CD & 100% CD, and two (2) hard copies to District.

1.5.5 Specifications shall be prepared in conformance with the most current edition available of Master Format of the Construction Specification Institute. Design Builder shall have complete responsibility to secure timely review and approval by all authorities with jurisdiction, including but not limited to the Division of the State Architect. It is the intent of the District to work in close coordination to assist the Design Builder in the plan review process to support a timely review and approval process schedule.

1.5.6 The same architectural and engineering team (and team personnel) that prepare documents submitted to authorities with jurisdiction shall complete the Construction Documents.

1.5.7 Compliance with Codes, Regulations and Requirements Prepare Construction Documents in full compliance with the Contract Documents, applicable building codes, ordinances, District standards, governmental regulations and private restrictions, applicable to the Work.

1.5.8 Make full written disclosure to District, and obtain District's express written approval of, any proposed innovative, unique, proprietary or sole source design features.

1.5.9 Warranty Design Builder warrants to District that the final design, as expressed in the Construction Documents: :

1.5.9.1 Will be constructible, workable, serviceable and within the Design Builder's detailed estimate of costs and schedule;

1.5.9.2 Will comply in all respects with the requirements of the Contract Documents (Certificate of Warranty) and (Certificate of Warranty Fire and Life Safety) listed in Section 00 45 00.

1.5.9.3 Will not call for the use of hazardous or banned materials.

1.5.9.4 Will fully comply with applicable building codes, ordinances, standards, governmental regulations and private restrictions, applicable to the Work.

1.5.10 Cost Estimate The Design Builder shall submit to the District an updated Cost Estimate and identify cost changes since the Proposal Estimate (providing one (1) electronic copy). This estimate shall consist of unit costs applied to the Element Level (Level 3 National Institute of Standards and Technology Uniformat II Classification) items and quantities of work. This estimate shall be organized in a format acceptable to the District. The District will use this estimate for cost reconciliation and design change order reviews.

1.6 CONSTRUCTION PHASE

1.6.1 Upon District's acceptance of Design Builder's Construction Documents for technical divisions or other portions of the Work as Design Builder and District may agree, Design Builder may commence construction of the Work shown.

1.6.2 General Administration of Construction Design Builder's architectural, design, and engineering, and other subconsultants, including the industrial hygienist, shall make regular visits to the site at intervals appropriate to the various stages of construction as necessary to assure that construction conforms to the final design of the Construction Documents as approved.

1.6.3 Quality Control and Reporting Design Builder's architectural, design, and engineering, and other subconsultants, including the industrial hygienist, shall participate fully in Design Builder's required quality control program and shall have a duty to advise Design Builder and District in writing of any observations of defective work, work not in conformance with Construction Documents, and lack of progress consistent with the schedule of work in areas associated with their services. See Section 01 45 00 (Quality Control).

1.6.4 Design Builder's architectural, design, and engineering subconsultants, including the industrial hygienist, shall establish and maintain to the satisfaction of District, a computer database compatible with databases maintained by District. The Design Builder's database shall maintain complete and accurate records regarding its activities related to fulfilling the requirements of Section 01 45 00 (Quality Control). Design Builder shall make such database available to District at all reasonable times and turn over the database in both hard and electronic form to District upon completion or termination of this Agreement.

1.6.5 Together with District, Design Builder and Design Builder's architectural, design, and engineering subconsultants, shall visit the Project to observe any apparent defects in the construction, correct such deficiencies, and supply information as needed regarding replacement, correction, or diminished value of defective work.

1.6.6 Design Builder shall provide to District for District's approval two (2) copies of a color schedule, samples of types and size acceptable to the District of textures and finishes of all materials in the Work at the Project. Actual materials to be used in the construction of the building shall be mounted on a board(s) suitable for display purposes for faculty, staff and the community to observe. Provide separate color boards for interior and exterior finishes.

1.7 OPERATION/PROJECT CLOSE-OUT PHASE

1.7.1 Operation/Close Out During the Operation/Project Close-Out Phase, Design Builder and Design Builder's architectural, design, and engineering subconsultants shall, when requested by District, provide all necessary architectural, design and engineering services, including services of its architectural, design and engineering subconsultants, for:

1.7.1.1 Refining, adjusting and correcting of any equipment or systems.

1.7.1.2 Start-up, testing and placing in operation all equipment and systems. See Section 01 35 50 (CALGreen Environmental Requirements).

1.7.1.3 Completion of punch list work and observation of any apparent defects in the completed construction, correction of such deficiencies, and supply information as needed regarding replacement, correction, or diminished value of defective work.

1.7.1.4 Training District's staff to operate and maintain all equipment and systems. Training shall be professionally videotaped with two (2) copies provided to District for their use.

1.7.1.5 Assisting District in developing systems and procedures for control of the operation and maintenance of and record keeping for the Project.

1.7.1.6 Preparation of electronic record sets and sets of reproducible record prints or Drawings showing those changes made during the construction process, based on the marked-up prints, Drawings and other data.

1.8 DESIGN BUILDER'S OBLIGATION FOR FINISHED CONSTRUCTION

1.8.1 District's right to review Design Builder's design including, but not limited to, Construction Documents, shop drawings, samples and submittals, as specified in the Contract Documents, shall not relieve Design Builder of its responsibility for a complete design and construction complying with the requirements of the Contract Documents; but rather, such review shall be in furtherance of the District's monitoring and accepting the design as developed and issued by the Design Builder, consistent with these Contract Documents. Design Builder's responsibility to design and construct the Project in conformance with the Contract Documents including, but not limited to, the applicable performance standard and any fully executed change orders, shall be absolute. Such duty may not be altered or diminished by any action other than a signed change order.

1.8.2 Auto CAD, Revit, and Other Electronic Data (BIM) Provide all electronic files of all Construction Documents drawings including as-bid, as-built, and all record Drawings. Prepare electronic record sets and sets of reproducible record prints or Drawings showing those changes made during the construction process. Electronic data shall conform to District requirements for compatibility with District equipment and software.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION (Not used)

END OF SECTION

1.1 RELATED DOCUMENTS

1.1.1. The Contract Documents, including Section 00 50 00 (Form of Agreement) and other Division 0 and 1 Specification Sections, apply to this Section.

1.2 USE OF PREMISES

1.2.1 Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.

1.2.1.1 Limits: Confine constructions operations to Limit of Work as shown in the Bridging Documents.

1.2.1.2 District Occupancy: Not Used.

1.2.1.3 Driveways, Entrances and Parking: Keep driveways, entrances and parking serving adjacent properties available for access and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

1.2.1.3.1 Schedule deliveries to minimize impact to adjacent properties and projects.
1.2.1.3.2 Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.2.2 Use of Existing Building: Maintain existing building in a weather-tight condition throughout construction period. Immediately repair damage caused by construction operations. Protect building and its occupants during construction period.

1.3 OCCUPANCY REQUIREMENTS

1.3.1 Full District Occupancy: Cooperate with District during construction operations to minimize conflicts and facilitate District usage. Perform the Work so as not to interfere with District's operations.

1.3.2 Partial District Occupancy: District reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1.3.2.1 District will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before District occupancy.

1.3.2.2 Obtain a Certificate of Occupancy from authorities having jurisdiction before District occupancy.

1.3.2.3 Before partial District occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, see Section 01 77 00 (Cleaning and Closeout Procedures) for requirements.

1.3.2.4 On occupancy, District will assume responsibility for maintenance and custodial service for occupied portions of building.

1.3.2.5 Prior to occupancy for each phase Design Builder shall satisfy all of the requirements as set forth in Section 01 77 00 (Cleaning and Closeout Procedures.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 – GENERAL

ENVIRONMENTAL CONTROLS

1.1.1 Noise: All work shall be performed with a minimum of noise or disruption to normal activities in the surrounding areas. Design Builder will allow up to twenty-one (21) Calendar Day notice for any work to be done outside the hours of Work allowed by Peralta Community College District.

1.1.2 The following noise control procedures shall be employed:

1.1.2.1 Maximum increase in noise shall be limited to approximately 15db over ambient and shall not exceed regulatory standards for noise.

1.1.2.2 The on-site construction supervisor shall have the responsibility and authority to receive and resolve noise complaints. A clear appeal process shall be established prior to construction commencement that will allow for resolution of noise problems that cannot be immediately solved by the site supervisor.

1.1.2.3 All noise-producing project equipment and vehicles using internal combustion engines shall be equipped with mufflers, air-inlet silencers where appropriate, and any other shrouds, shields, or other noise-reducing features in good operating condition that meet or exceed original factory specification. Mobile or fixed "package" equipment (e.g., arc-welders, air compressors) shall be equipped with shrouds and noise control features that are readily available for that type of equipment.

1.1.2.4 All mobile or fixed noise-producing equipment used on the project, which is regulated for noise output by a local, state, or federal agency, shall comply with such regulation while in the course of project activity.

1.1.2.5 Electrically-powered equipment instead of pneumatic or internal combustion powered equipment shall be used, where feasible and needed to control excessive noise.

1.1.2.6 Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise-sensitive receptors.

1.1.2.7 Construction site and access road speed limits shall be established and enforced during the construction period.

1.1.2.8 The hours of material transport shall be restricted to the periods and days permitted by both this contract and local noise or other applicable ordinance.

1.1.2.9 The use of noise producing signals, including horns, whistles, alarms, and bells shall be for safety warning purposes only.

1.1.2.10 No project related public address or music system shall be audible at any adjacent noise-sensitive receptor.

1.1.3 Dust: Dust control is a critical activity. The Design Builder shall prepare a submittal that identifies source air pollution and related pollution reduction measures. The following dust control measures shall be employed:

1.1.3.1 Implement fugitive dust control measures as provided in Bay Area Air Quality Management District (BAAQMD).

1.1.3.2 Develop a staging area, vehicle and truck routes, and a daily meeting to assure all applicable control measures are established for that particular workday.

1.1.3.3 Dust barriers shall be provided by the Design Builder as necessary to contain dust within the construction site.

1.1.3.4 If necessary, install a water misting system along fence perimeter or any other necessary area to prevent fugitive dust from creating a.

1.1.3.5 Reduce the use of diesel fuel powered equipment and use equipment with alternative fuel whenever practical to minimize diesel exhaust emissions in areas close proximity to the site.

1.1.3.6 Turn off equipment when not in use for long periods of time. No idling of diesel-fueled equipment for durations longer than five minutes.

1.1.3.7 Control fugitive dust at active soil grading/excavation areas, using water in a manner

that would not impact soil compaction. Continuous wet-down may be required in the area of construction activity.

1.1.3.8 Use ground-covering such as mulch, wood chips, straws, hydro-seeding, surfactants, or plastic sheeting to cover inactive exposed areas to minimize fugitive dust.

1.1.3.9 Provide drainage for erosion control measures.

1.1.3.10 Use sand bags, as necessary, along site perimeter to keep soil on site.

1.1.3.11 Provide gravel entry way into construction site entrance to reduce/eliminate mud and sediment carried off site by vehicles.

1.1.3.12 Cover top of haul trucks to eliminate wind-blown fugitive dust.

1.1.3.13 Schedule haul trucks and material delivery trucks to prevent traffic congestion. Set up truck queuing area and have staff communicate via cell phone for efficiency.

1.1.3.14 As necessary, use street sweepers along travel routes in general vicinity of project area.

1.1.3.15 All vehicle routes are to be watered for dust control. All existing roadway and parking surfaces impacted by construction activity are to be swept and kept free of debris and dust. All areas within the construction site are to be broom swept as required to keep dust and debris to a minimum.

1.1.3.16 Limit the number of haul trucks on site and establish a haul route. Install a gravel or base road on site for loading trucks. Haul route shall be reviewed and approved by District.

1.1.3.17 Place on-site portable toilets away from adjacent properties.

1.1.3.18 All stockpiles shall be kept moist throughout the day to minimize particulate matter emissions. Wet down stockpiles on a regular basis including prior to end of work day.

1.1.3.19 Haul roads shall be paved, lined with gravel or base material, or kept moist to minimize particulate matter emissions.

1.1.3.20 Where practical, use paddle-wheel scrapers instead of traditional scrapers to minimize fugitive dust and reduce exhaust emissions.

1.1.3.21 Handling of soil shall be kept to a minimum.

1.1.3.22 Provide a boundary/zone where equipment shall not enter and if necessary, equipment shall operate on alternative fuel to reduce diesel particulate matter.

1.1.4 Odors: When odors are a concern, arrangements shall be made by the Design Builder for their containment or control. Where this is not feasible, specific arrangements should be made to minimize disturbance to surrounding properties. Where controllable, fumes and odors shall not be allowed to migrate. The Design Builder shall immediately notify the District's Representative of any migrating odors.

1.1.5 Vibrations: The impacts of vibration activities will be limited. If vibration becomes an impact to surrounding properties, the Design Builder shall stop operations, reschedule and/or implement the following with the approval of the District Representative:

1.1.5.1 Route heavily loaded trucks and equipment away from surrounding residential properties if possible.

1.1.5.2 Phase earthmoving and ground-impacting operations so as not to occur in the same time period, to the extent practicable. The total vibration level produced could be less when each vibration source operates separately.

1.1.5.3 Avoid vibratory rollers and packers near vibration-sensitive areas.

1.1.6 Environmental Mitigation Measures: Design Builder shall become familiar with the full text of the project's Environmental Impact Report/Negative Declaration Report and take responsibility for implementation of applicable mitigation measures. Questions about which items are applicable to the Design Builder shall be directed to the District's Representative.

1.2 SHIPMENTS AND MATERIALS

1.2.1 Equipment and materials shall not be shipped to the site unless specific arrangements are made for receipt and acceptance of these items. When

such shipments are authorized, they are the total responsibility of the Design Builder. The District accepts no responsibility for the receipt, storage, or protection of the Design Builder's materials and equipment.

1.3 SALVAGE AND DISPOSAL

1.3.1 All existing property of the District that is removed from the construction site and has been identified to be salvaged by the District shall be delivered to a secure site as specified by the District's Representative.

1.3.2 Construction debris, or material that has no redeemable value, is to be placed in Design Builder-furnished refuse bins for safe and legal removal from the premises. District refuse bins may not be utilized unless so authorized by the District.

1.4 PARKING

1.4.1 The District's Representative will meet with the Design Builder to determine parking requirements.

1.4.2 The primary parking and storage areas shall be designated.

1.4.3 Design Builder and related personnel shall park in authorized areas only.

1.5 SANITARY

1,5,1 Design Builder shall provide temporary toilet facilities adjacent to areas of Work. The Design Builder will not be allowed to use project site restroom facilities being constructed.

1.5.2 Design Builder shall submit proposed location of temporary toilet(s) to the District's Representative for approval.

1.5.3 Construction personnel will not be allowed to use restroom facilities being constructed for personal or equipment clean-up.

1.5.4 Sanitary Facilities shall be in accordance with OSHA regulations.

1.6 FOOD

1.6.1 Construction personnel shall police their own areas during breaks. All cups, cans, paper, wrappers, and discarded food must be placed in trash receptacles at the end of each break.

1.6.2 Design Builder shall submit the proposed location of any break and eating areas to the District's Representative for approval.

1.6.3 Construction personnel are not allowed to have food within the project, whether those facilities exist or are under construction.

1.7 ITEMS to be included in DBE lump sum General Conditions in RFP Proposal shall include, but are not limited to the following:

1.7.1 Offsite parking for DBE administrative, management and Supervisory staff, craft labor included in general conditions (ie clean-up and safety workers).

1.7.2 Temporary toilets and hand wash stations, compliant with all COVID-19 requirements.

1.7.2.1 Refer section 01 52 00 for further detail on items to be inlcuded

1.7.3 Temporary barricades, fencing, gates to protect all students, faculty, staff and general public from construction activities. Barricades shall be lit as necessary for safety and security and shall be continuously maintained.

1.7.4 General clean-up of construction site on a daily basis, including debris boxes and off-site removal of trash.

1.7.5 Final clean-up – removal of all debris, construction related items, packaging, scraps etc., clean all surfaces of construction dust, materials.

1.7.6 COVID-19 costs, as required by AHJ, for temperature taking, reporting, sign-n sheets, sanitization of work areas, tools etc..

1.8 SMOKING AND TOBACCO

1.8.1 Smoking, and chewing tobacco are not permitted on the Project site.

1.8.2 Smoking and chewing tobacco are not permitted within the facilities during or after construction.

1.9 SECURITY

1.9.1 Comply with requirements of Article 14 of Section 00 50 00 (Form of Agreement).

1.9.2 All personnel must obey and act immediately upon any request by District security or law enforcement personnel.

1.9.3 A list of emergency phone numbers will be provided by the District Representative.

1.10 SAFETY

1.10.1 General

1.10.1.1 Watch for guests, invitees, and unauthorized personnel at all times.

1.10.1.2 Work only where there is a positive barrier separation, with “green screen” between construction activities and others.

1.10.1.3 Clean up all areas immediately in occupied areas.

1.10.1.4 Do not drape cords across corridors. All cords must be attached to the ceiling or taped to the floor (use tape with non-marring adhesive).

1.10.1.5 Maintain a minimum of 8’-0” clear within all corridors.

1.10.1.6 Do not leave materials or equipment in the corridor.

1.10.2 Safety equipment and consideration should include, but are not limited to:

1.10.2.1 Anyone known to be under the influence of alcohol or drugs shall be dismissed from the Project at once and not be allowed to return.

1.10.2.2 Offensive language is not permitted in any area where it may be overheard by surrounding properties.

1.10.2.3 Provide adequate emergency first aid equipment.

1.10.2.4 Post location and emergency phone numbers for local medical care.

1.10.2.5 Monitor safe ladder usage.

1.10.2.6 Provide exhaust controls for equipment.

1.10.2.7 Monitor noise levels and establish safe limitations.

1.10.2.8 Ensure adequate ventilation for air contaminants.

1.10.2.9 Insist on personal protective equipment, such as hard hats, safety shoes, and eye, ear, and face protection equipment.

1.10.2.10 Safety nets, belts, and lifelines shall be used, as appropriate.

1.10.2.11 Provide adequate emergency fire protection equipment.

1.10.2.12 Post location and emergency phone numbers for local fire departments.

1.10.2.13 Provide safe storage for all flammable and combustible materials.

1.10.2.14 Insist on safe and proper use of hand power tools and electrical drop cords.

1.10.2.15 Operation of cranes, derricks, and hoists should be in accordance with manufacturer's recommendations and appropriate ANSI and CAL-OSHA regulations.

1.10.2.16 All construction operations and personnel are subject to CAL-OSHA and applicable District Environmental Health & Safety regulations.

1.10.2.17 Provide adequate barricades and safety lighting at all open trenches adjacent to public access.

1.10.2.18 Properly fence entire confines of project site so as to avoid public access or unauthorized personnel.

1.10.2.19 All wall, floor, and ceiling penetrations shall be sealed to maintain fire and smoke ratings in accordance with CBC, NFPA 99 and Life Safety Code.

1.10.2.20 All emergency exit passages must be maintained free of obstructions.

1.10.2.21 Provide barricades and fencing in accordance with Section 00 50 00 (Agreement) or applicable law.

1.10.3 Fire Prevention During Welding, Cutting, and Other Hot Work

1.10.3.1 All hot work shall be in accordance with industry standards and CAL-OSHA requirements.

1.10.3.2 Hot work includes welding, heat treating grinding, thawing pipe, powder-driven fasteners, hot riveting, and similar applications producing a spark, flame, or heat.

1.10.3.3 The Design Builder shall ensure that only approved apparatus, such as torches, manifolds, regulators, or pressure-reducing valves, and acetylene generators, are used.

1.10.3.4 The Design Builder shall ensure that all individuals involved in hot work are:

1.10.3.5 Trained in the safe operation of their equipment and the safe use of the process.

1.10.3.6 Have an awareness of the inherent risks involved and understand the emergency procedures in the event of a fire.

1.10.3.7 Are aware if any special risks, such as flammable materials or hazardous conditions at the hot work site.

1.10.4 Project Inspector

1.10.4.1 Provision of inspectors by the District, if any, pursuant to provisions of this section shall be subject to following:

1.10.4.1.1 Design Builder shall allow inspectors full access to project at all times Work is in progress.

1.10.4.1.2 Design Builder shall not take any direction, approvals or disapprovals from inspectors.

1.10.4.1.3 Design Builder shall not rely on inspectors to ensure Work is completed in accordance with Contract documents.

1.10.4.2 Acts or omissions of any inspector (including, without limitation, inspector's failure to observe or report deficiencies in Design Builder's Work) shall not relieve Design Builder from its responsibility to complete Work in accordance with Contract documents.

1.10.5 Directory For Assistance: A list of emergency phone numbers will be provided by the Engineering Department Service Center or the District's Representative.

1.11 PCCD COVID-19 Protocol

1.11.1 DBE and all vendors (firm/company/contractor) should follow the Alameda County Health Department's mandated COVID-19 workplace safety and health guidelines. Workers working under the Contract shall comply with all applicable laws, ordinances, rules, regulations and lawful orders of public authorities bearing on the safety of persons or property, or their protection from damage, injury or loss. Vendors shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Work.

DBE shall include all costs from said COVID-19 compliance in their RFP General Conditions proposal and in subsequent trade bid packages, including all direct cost impacts as well as indirect impacts such as loss of efficiency, vertical transportation, social distancing, sanitizing of tools, equipment and work areas, personal protective equipment, temperature taking, sign-in sheets, tool box meetings, reporting, documentation etc..

Refer https://safe.peralta.edu/ for the most up-to-date District information and resources regarding COVID-19 for students, faculty/staff, and the community.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes administrative, procedural, and technical requirements for bid Alternates. An Alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if established in the Agreement.

2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum. Except as specifically indicated, the Work described in Alternates shall be completed with no increase in Contract Time.

3. This Section includes only the non-technical descriptions of the Alternates. Refer to the specific Sections of the Specifications for the technical description of the Alternates.

1.2 PROCEDURES

A. Part 3 of this Section identifies each Alternate by number and describes basic changes to be incorporated into the Work, only when that Alternate is made a part of the Work by specific provisions in the General Conditions and/or Division 1.

B. Location of each Alternate Bid is indicated on the Drawings.

C. Scope: Base Bid and Alternates shall include cost of all supporting elements required, so that no matter what combination of Base Bid and Alternates are accepted, that portion shall be a complete entity in itself. Scope of Work for all Alternates shall be in accordance with applicable Drawings and Specifications. Drawings specified herein are not all inclusive but are listed for guidance in the location of each Alternate. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

D. Notification: Immediately following award of Contract, prepare and distribute to each party involved, notification of status of each Alternate. Indicate whether Alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to Alternates.

E. Execute accepted alternates under the same conditions as other Work of the Contract. Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. General: The bid alternates itemized below are listed in their order of priority, from highest to lowest.

1. Alternate No. 1 – Classroom Resilient Flooring Alternate.
    a. Base Bid: Resilient flooring finish in classroom spaces as indicated in Drawings and as specified.
    b. Alternate: Propose Value Alternate flooring finish product in classroom spaces.
2. Alternate No. 2 – Classroom Resilient Flooring Removal.
    a. Base Bid: Resilient flooring finish in classroom spaces as indicated in Drawings and as specified.
    b. Alternate: Polished concrete floor in classroom spaces.
3. Alternate No. 3 – Exposed Concrete.
    a. Base Bid: Sack and patch exposed concrete as specified.
    b. Alternate: Remove sack and patch concrete requirement. All concrete walls Class 2 per specification only.
4. Alternate No. 4 – Benches.
    a. Base Bid: Built-in custom benches located at Floors 2-6 corridors, as indicated in Drawings and specified.
    b. Alternate: Propose Value Alternate to modify/simplify fabrication and/or installation.
5. Alternate No. 5 – Steel Picket Fencing.
    a. Base Bid: Decorative steel picket fencing as specified.
    b. Alternate: Propose value alternate.
6. Alternate No. 6 – Telecommunications Cable.
    a. Base Bid: Category 6A (CAT6A) cable standard as indicated in Drawings and as specified.
    b. Alternate: Category 6 (CAT6) cable standard where CAT6A is indicated in Drawings and specified.

7. Alternate No. 7 – Roof Deck Shade Structure.
   a. Base Bid: No shade structure. Include light fixtures on north wall of terrace per Drawings.
   b. Alternate: Add shade structure at roof deck as shown on A-113 & associated details, inclusive of sprinklers and lighting as indicated.
8. Alternate No. 8 – Corridor Wall Wash Fixtures.
   a. Base Bid: Lighting as shown on Drawings and specified.
   b. Alternate: Add Wall Wash F3 type fixtures to Main Corridor, Floors 1-3, 5-6.
9. Alternate No. 9 – Marquee LED Lighting.
   a. Base Bid: Marquee lighting as shown on Drawings and specified.
   b. Alternate: Add RGBW LED Lighting at Column A-X2, Floors 1-5.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

1.1.1 This section describes requirements for job site administration, including:

1.1.1.1 District's Representative
1.1.1.2 Design Builder's Project Management Team.

1.1.2 Related Sections.

1.1.2.1 Section 00 50 00 (Form of Agreement)
1.1.2.2 Section 01 11 13 (Work Covered by Contract Documents)
1.1.2.3 Section 01 33 00 (Submittal Procedures)
1.1.2.4 Section 01 70 00 (Execution and Closeout Procedures)

1.2 DISTRICT'S MANAGEMENT TEAM

1.2.1 The District shall be represented on this Contract by Atheria Smith serving as District's Representative, who will act personally or through authorized designees. The District has designated Keith Kajiya, AECOM PCCD Bond Program Manager to represent the District in carrying out the duties of District. The District may delegate all or a portion of the District's Representative's duties to a Construction Manager, Bob Parks, Kitchell CEM or other District Representative, which shall then perform all or a portion of the District's Representative's duties specified herein.

1.2.2 Functions of the District's Representative include, but are not limited to, the following:

1.2.2.1 The District's Representative functions as the primary point of contact with the Design Builder in all matters concerning the Contract, monitoring the Design Builder's performance in all respects to ascertain that the Work is performed in accordance with all of the requirements of the Contract.

1.2.2.2 The District's Representative is the focal point of contact with the Design Builder regarding clarification of discrepancies and resolution of questions of fact that arise during performance of the Work under the Contract. The District's Representative also performs this role with regard to all agency and utility construction interfaces with the Work under this Contract.

1.2.2.3 The Design Builder is required by the Contract to provide formal notice of any and all potential claims arising during the performance of the Work. The District's Representative will administer the processing and resolution of any such claims in accordance with the requirements of the Contract.

1.2.2.4 All contractual correspondence, including submittals, shall be directed and processed through the District's Representative unless otherwise specifically directed in the Contract. Any required or requested communications between the Design Builder and District, the District's Representative, or any other representative of District, will be coordinated by the District's Representative.

1.3 DESIGN BUILDER'S PROJECT MANAGEMENT TEAM

1.3.1 The Design Builder shall staff the Project with a management team qualified and experienced in construction of a public works project of this value, nature and complexity including the individuals identified by Design Builder in its Proposal. This team shall possess the competency, skills and authority specified in Section 00 50 00 (Agreement).

1.3.1.1 The Design Builder shall submit to the District prior to Notice to Proceed, the names, detailed project experience, references, and proposed project position for each team member. Key team members shall have appropriate experience in the proposed position.

1.3.1.2 The Design Builder shall not replace members of the Design Builder's management team without prior written approval of the District. If, during the course of the Project, the Design Builder finds it necessary to replace a member of the Project Management Team, the name, qualifications, and experience of the proposed replacement shall be submitted to District for approval.

1.3.2 The Project Management Team shall be composed of members with the necessary skills and be sufficient in number to handle all duties normal to a project of this scale and complexity. Special attention shall be given to the responsibility of the Project Management Team for coordination and scheduling.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

1.1.1 This section describes the required project meetings for this work. These meetings include:

1.1.1.1 Collaboration, Design and Preconstruction Conferences.
1.1.1.2 Coordination Meetings
1.1.1.3 Progress Meetings
1.1.1.4 Scheduling Meetings.
1.1.1.5 Quality Control Meetings
1.1.1.6 Special Meetings.

1.1.2 Related Sections.

1.1.2.1 Section 00 50 00 (Form of Agreement)
1.1.2.2 Section 01 11 00 (Work Covered by Contract Documents)
1.1.2.3 Section 01 11 20 (Design Services and Deliverables)
1.1.2.4 Section 01 33 00 (Submittal Procedures)

1.2 DESIGN & PRECONSTRUCTION CONFERENCE

1.2.1 District will call for and administer Collaboration, Design and Preconstruction Conferences at times and places to be announced. A Design Confirmation Conference will occur as soon after issuance of the Notice to Proceed as can be reasonably scheduled. Preconstruction Conferences will be scheduled no later than 30 days prior to the start of construction of the Work.

1.2.2 Design Builder, all Subconsultants and major suppliers shall attend the Design Confirmation Conference(s). Agenda will include, without limitation, the following items:

1.2.2.1 Design Builder and District Coordination and Meeting Procedures
1.2.2.2 Design Builder's Design Confirmation Plan with Subconsultants
1.2.2.3 Design Builder's Initial CPM Schedule for Design and Construction
1.2.2.4 Design Builder's Schedule of Values (including design activities)
1.2.2.5 Design Builder's Schedule of Deliverables and Agency Submittals

1.2.3 Design Builder, all Subcontractors, and all major suppliers shall attend the Preconstruction Conference(s). Agenda will include, without limitation, the following items:

1.2.3.1 Schedules
1.2.3.2 Personnel and vehicle permit procedures
1.2.3.3 Use of premises/Limits of Work
1.2.3.4 Location of the Design Builder's on-site facilities
1.2.3.5 Security
1.2.3.6 Site specific safety plan

1.2.3.7 Housekeeping
1.2.3.8 Design Builder's Quality Control Program
1.2.3.9 Submittals
1.2.3.10 Inspection and testing procedures, on-site and off-site
1.2.3.11 Utility shutdown procedures
1.2.3.12 Control and reference point survey procedures
1.2.3.13 Injury and Illness Prevention Program
1.2.3.14 Design Builder's Updated CPM Schedule
1.2.3.15 Design Builder's Schedule of Values
1.2.3.16 Design Builder's Schedule of Submittals

1.2.4 District will distribute copies of minutes to attendees. Attendees shall have five (5) Business Days to submit comments or additions to minutes. Minutes will constitute final project record of results of any conference.

1.3 COORDINATION MEETINGS

1.3.1 Collaboration and Design Phase Coordination

1.3.1.1 District will be available to participate in Design Confirmation meetings or workshops as deemed necessary by the Design Builder.

1.3.1.2 Design Builder shall conduct at least weekly design coordination meetings with all subconsultants employed by the Design Builder. Design Builder shall invite the District or its representative to participate in these meetings.

1.3.2 Construction Phase Coordination

1.3.2.1 District will be available as necessary to participate in Construction Phase Coordination Meetings.

1.3.2.2 Design Builder Construction Phase Coordination shall be integrated with the Design Builder's Quality Control Program, see Section 01 45 00 (Quality Control).

1.3.2.3 Design Builder shall conduct at least monthly Construction Phase Coordination Meetings with all Subcontractors employed by Design Builder. Design Builder shall invite District's representative to attend these meetings. Design Builder shall invite District to attend Design Builder's Quality Control Meetings.

1.4 PROGRESS MEETINGS

1.4.1 District will schedule and administer Progress Meetings throughout the duration of Design and Construction Work. Progress meetings will be held weekly unless otherwise directed by District.

1.4.1.1 Design Phase Progress Meetings shall be held at the offices of the Design Builder's Architect or at the Office of the District as is mutually

agreed upon in advance by Design Builder and District Representative to be most advantageous for completing the Work.

1.4.1.2 Construction Phase Meetings shall be held at the Design Builder's Site office unless otherwise agreed between Design Builder and the District.

1.4.1.3 District will prepare an agenda and distribute it to the Design Builder and any Inspector in advance of the meeting.

1.4.1.4 District will preside at and conduct the meeting.

1.4.1.5 District will record and distribute minutes to the Design Builder, Inspectors, all other participants, and those affected by decisions made at a meeting, within five (5) Business Days after each meeting. Attendees shall have five (5) Business Days to submit comments or additions to the minutes. Minutes will constitute final project record of results of meeting.

1.5 SCHEDULING MEETINGS

1.5.1 Initial Schedule Review

1.5.1.1 Design Builder shall meet with the District and conduct initial review of the Design Builder's draft: Design Schedule, Design Deliverables Schedule, Shop Drawing and Sample Submittal Schedule, Schedule of Values, and Progress Schedule.

1.5.1.2 An authorized representative in the Design Builder's organization, designated in writing and who will be responsible for working and coordinating with District relative to preparation and maintenance of Progress Schedule, shall attend the initial review meeting.

1.5.2 Schedule Update Meetings

1.5.2.1 District will administer scheduling update meetings monthly and will distribute minutes of scheduling meetings to attendees. Details for Schedule Update Meetings shall conform to the description provided in Section 00 50 00 (Agreement).

1.6 QUALITY CONTROL MEETINGS

1.6.1 Design Builder shall conduct at a minimum weekly Quality Control Meetings as part of the Design Builder's Quality Control Program, see Section 01 45 00 (Quality Control).

1.6.2 Design Builder's attendees at Quality Control Meetings shall at a minimum include:

1.6.2.1 Design Builder's Quality Control Manager

1.6.2.2 Design Builder's Commissioning Coordinator; as required
1.6.2.3 Design Builder's Safety Officer
1.6.2.4 Subcontractors actively working on Site or preparing to mobilize.
1.6.2.5 Representatives of manufacturers and fabricators; as required
1.6.2.6 Design Builder's Architect
1.6.2.7 Subconsultant Engineers as activities dictate.

1.6.3 District's attendees at Quality Control Meetings shall at a minimum include:

1.6.3.1 District's Representative
1.6.3.2 District's Inspector of Record

1.6.4 Quality Control Meetings agendas shall include at a minimum:

1.6.4.1 Submittal Review, including approval status and schedule

1.6.4.1.1 Product Data and Material Safety Data Sheets (MSDS)
1.6.4.1.2 Shop Drawings & Coordination Documents
1.6.4.1.3 Substitutions and Modifications Requests
1.6.4.1.4 Manufacturer's Installation Requirements & Instructions
1.6.4.1.5 Manufacturer's Operating Requirements & Instructions

1.6.4.2 Distribution of Testing and Inspection Reports

1.6.4.3 Review of In-progress activities for compliance and timeliness.

1.6.4.4 Coordination of Upcoming Testing, Inspection and Observation Procedures & Requirements

1.6.4.5 Summary of activity successes, deficiencies, and corrective measures

1.7 SPECIAL MEETINGS

1.7.1 Preparatory Meetings as activities dictate for Testing, Inspection and Observation.

1.7.2 Commissioning Meetings per approved Commissioning Plan and Schedule.

1.7.2.1 Pre-Commissioning Planning
1.7.2.2 Commissioning Plan Review
1.7.2.3 Commissioning Scheduling and Procedures

1.7.3 Community Meetings as directed by District.

1.7.4 Ad Hoc Meetings as directed by District.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

1.1.1 All Contract Documents apply to the work of this section.

1.1.2 This section contains general information that applies to all work performed under the Contract, and is made inherently a part of each specification section.

1.2 GENERAL PROJECT MANAGEMENT

1.2.1 The District hereby directs Design Builder to use the Project's Internet/Web-based project management software to track and manage the Project.

1.2.2 Use of this project management software will not replace or change any contractual responsibilities of the project team members.

1.2.3 Each Project Team Member of the Design Builder: Superintendent, Project Engineer, Scheduler, and Project Manager, etc., shall have access to the Internet and an Internet e-mail address in order to communicate with various project team members. The Design Builder shall provide immediately upon receipt of the Notice to Proceed confirmation of these conditions and the names, positions, and e-mail addresses to the District.

1.3 SOFTWARE AND HARDWARE REQUIREMENTS

1.3.1 The Design Builder is required to provide at both the field office and home office locations from where this project is managed, the computer hardware, software and high speed Internet access that meet the requirements of the Web- Based project management software. This Software is intended to be a web-based application that does not require the Design Builder to purchase. The Design Builder will be given the ability to create additional user logins so that it may give access to those it determines to be necessary at no additional cost. Design Builder's access to the Locker Room Renovation Project Web-Based database will be limited to in accordance with permission levels configured by the District.

1.3.2 The District shall provide the Design Builder with Web-Based software training (if required). The anticipated training will take place after the Notice to Proceed has been issued and will be held in Oakland, California. The District will pay for the training course only for up to twenty (20) Design Builder staff members. Training for Design Builder is expected to be completed in up to two separate half day sessions. Training for additional staff can be arranged directly with Web-Based Software team at additional cost to the Design Builder.

1.3.3 The administrator for this project is the District's Representative or authorized designee.

1.3.4 The Design Builder shall provide an adequate number of trained users to properly manage the Project in accordance with the Project schedule. The Design Builder shall have Internet access through an Internet service provider of

its choice at its cost.

1.3.5 Software requirements are as follows:

1.3.5.1 A 32-bit operating system such as Windows XP or above with Service Pack 2 or above
1.3.5.2 Internet Explorer Version 7.0 or above

1.3.6 Hardware requirements are as follows:

1.3.6.1 Pentium based (or equivalent) workstation or laptop
1.3.6.2 32 megs of RAM minimum; ideally 128 megs of RAM or above
1.3.6.3 A connection to the Internet (128 kb/s or above)

1.3.7 More information on Web-Based Project Management software information will provide later in design phase.

1.4 SYSTEM MANAGEMENT AND USE

1.4.1 The District's Representative will administer the Web-Based Project Management Software user account.

1.4.2 All costs associated with using this system, including computer hardware and internet service are the responsibility of the Design Builder.

1. 5 USE BY SUBCONTRACTORS

1.5.1 The District encourages the Design Builder to utilize Web-Based project management software for communicating with its Subcontractors. The Design Builder shall inform all Subcontractors of the purpose of the project management system and how it can assist them in obtaining information for the project.

1.6 COMMUNICATION PROCESS

1.6.1 The District's Representative will outline and detail communication, correspondence and coordination procedures at the initial Project Team meeting.

1.6.2 Most Project communication will take place in the Web-Based project management system by creating and distributing documents directly within the system, or by entering manually in the system dates and descriptions of items to track over time. All documents requiring formal signatures will be printed, and their hard copies signed and distributed.

1.6.3 The official submittal log will be maintained within Web-Based project management system. The Design Builder will use the Web-Based project management transmittal format for each submittal transmittal; however, the Design Builder will distribute prints, documents, reports, samples, etc. in the traditional manner, outside the system. TheWeb-Based project management system will be used to track and expedite processing of these items.

1.6.4 Design Builder will be required to maintain all current drawings within Web-

Based project management system, including but not limited to the Program Verification and Design Development process as well as the development of the Construction Documents. The Design Builder will be able to control administration of the drawings which includes but is not limited to: the ability to create a custom folder structure; folder-level permissions; auto-notifications for certain events (e.g., delete, check out) using Web-Based project management messaging system and the user's email address; auto-detection and uploading of a drawing's reference files; detailed history for a document, including revisions and access logs; check-in and check-out capabilities; view and markup capabilities.

1.6.5 Design Builder will be required to utilize modules including but not limited to: daily reports; meeting minutes; punch lists; requests for information (RFI); change items; cost events; and owner change order within the Web-Based project management system. The Design Builder can enter a RFI and the Architect/Engineer respond to the RFI completely within the Web-Based project management system without creating a hard copy. Support documentation in hard copy format for any document in Web-Based system may be scanned into an electronic file and attached in Web-Based system to documents.

1.6.6 Design Builder is required to use a digital camera in order to photo-document job progress and upload the associated images taken on a regular basis to the Web-Based system. Each report required under Section 00 50 00 (Agreement) should be accompanied by progress photograph(s). Cost for digital camera to be borne by Design Builder.

1.7 ARCHIVING

1.7.1 District may, at its cost and expense, obtain backups (on CDs or otherwise) of documents in Web-Based system. In the event of any dispute as to what items are the true and correct project records, items contained on the backups will control.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 Project Management Application is an Internet-Accessed Centralized Database of project information and consists of several separate modules or master file divisions for ease of organization. Available file divisions include but are not limited to: Correspondence, Daily Reports, RFI's, Transmittals, Submittals, Meetings, Documents, Drawings, Specifications, Punch Lists, Reports, Project Photos, Project Team, Schedule of Values, change items, cost events, owner change orders, owner request for proposals, etc.

3.2 The District shall provide the Design Builder with access to the BCC West Project in Web-Based software described in paragraph 1.3.1 above. Each major team member for the Design Builder (i.e. project manager, superintendent, architect, etc.) must have

access to Web-Based software and the required training to access the system. The Design Builder shall insure that all major team members on this project have Internet access available and access to Web-Based system during the duration of this Project.

3.3 Major Subcontractors are encouraged to utilize Web-Based project management software for the duration of their scope of work from commencement to completion of their scope of work. Major Subcontractors as a minimum shall be defined as sitework, mechanical, electrical, plumbing, structural, civil, landscape, telecommunications, concrete/masonry, security, storefront/windows, metal panels, drywall, roofing, and others deemed beneficial by the Design Builder.

All other Subcontractors and suppliers shall utilize email or fax for submission of documents to the Design Builder.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

Design Builder and District will jointly develop a list of submittals and shop drawings that are to be submitted to the District. Upon completion of the list, Design Builder will provide District with a preliminary schedule of shop drawings and submittals, which will list each submittal in order by specification section and the times for submitting, reviewing, and processing such submittal.

1.1.1 This section describes general requirements for submittals for the Construction Phase of the Work :

1.1.1.1 Procedures
1.1.1.2 Schedule of Shop Drawing and Sample Submittals
1.1.1.3 Safety Plan
1.1.1.4 Progress Schedule
1.1.1.5 Product Data
1.1.1.6 Shop Drawings
1.1.1.7 Samples
1.1.1.8 Quality Control Submittals
1.1.1.8.1 Engineering Data
1.1.1.8.2 Test Reports
1.1.1.8.3 Certificates
1.1.1.8.4 Manufacturers' Instructions
1.1.1.9 Machine Inventory Sheets
1.1.1.10 Operations and Maintenance Manuals
1.1.1.11 Computer Programs
1.1.1.12 Project Record Documents
1.1.1.13 Delay of Submittals

1.1.2 Related Sections

1.1.2.1 Section 00 50 00 (Agreement)
1.1.2.2 Section 01 11 13 (Work Covered by Contract Documents)
1.1.2.3 Section 01 11 20 (Design Services and Deliverables)
1.1.2.4 Section 01 31 91 (Project Meetings)
1.1.2.5 Section 01 45 00 (Quality Control)
1.1.2.6 Section 01 60 00 (Product Requirements)
1.1.2.7 Section 01 77 00 (Cleaning and Closeout Procedures)
1.1.2.8 Section 01 91 00 (Commissioning Requirements)

1.1.3 For Design Phase Deliverable Requirements, see Section 01 11 20 (Design Services and Deliverables).

1.2 PROCEDURES

1.2.1 Submit five (5) sets in addition to required quantities for Design Builder team members, Schedule of Shop Drawing and Sample Submittals, Safety Plans, Progress Schedule, Product Data, Shop Drawings, Samples, Quality Control Data, Machine Inventory Sheets, Operations and Maintenance Manuals,

Computer Programs, and Project Record Documents required by the Contract Documents. In lieu of physical copies of paper submittals, the Design Builder may request to submit electronic copies.

1.2.2 Transmit each item with a standard letter of transmittal in form approved by District. Address to both District's Representative and Inspector of Record. One copy will be returned to Design Builder only when District action is required, generally where variations to the approved Contract Documents are desired.

1.2.3 Identify Design Builder, Subcontractor, subconsultant, major supplier, pertinent drawing sheet and detail number, and specification section number as appropriate. Provide space for District approval.

1.2.4 Where manufacturers' standard drawings or data sheets are used, they shall be marked clearly to show those portions of the data which are applicable to this Project.

1.2.5 Submit Shop Drawings, Samples, Product Data and other submittals (collectively, "Submittals") to District for review and action in accordance with accepted Schedule of Submittals. Also see Section 01 45 00 (Quality Control). It is the intent that during the construction phase routing of Submittals to the District is informational for purposes of coordination and communication to the District's Representatives and Inspector of Record, except where such submittals represent deviations or substitutions from the approved construction documents then requiring District's review and approval.

1.2.6 The data shown on all Submittals shall be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show District the materials and equipment Design Builder proposes to provide and to enable District to review the information for the limited purposes specified below. Samples shall be identified clearly as to material, supplier, pertinent data such as catalog numbers and the use for which it is intended and otherwise as District may require to enable District to review the submittal. The number of each Sample to be submitted will be as specified in the Specifications.

1.2.7 At the time of each submission, Design Builder shall give District specific written notice of all variations, if any, that the Submittal may have from the requirements of the approved Contract Documents, and the reasons therefore. This written notice shall be in a written communication separate from the Submittal. In addition, Design Builder shall cause a specific notation to be made on each Submittal submitted to District for review and approval of each such variation.

1.2.8 If District accepts such variation, it shall issue an appropriate Contract Modification with return to Design Builder of a reviewed set of the Submittal.

1.2.9 Submittal coordination and verification is the responsibility of Design Builder and its Subcontractors. Before submitting each Submittal, Design Builder and its Subcontractors shall have determined and verified:

1.2.9.1 All field measurements (where possible), quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto;

1.2.9.2 All materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work; and

1.2.9.3 All information relative to Design Builder's sole responsibilities and of design and means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

1.2.10 Design Builder shall also have reviewed and coordinated each Submittal with other Submittals and with the requirements of the Work and the Contract Documents.

1.2.11 Design Builder's submission to District of a Submittal will constitute Design Builder's representation that it has satisfied its obligations under the Contract Documents, and as set forth immediately above, with respect to Design Builder's review and approval of that Submittal.

1.2.12 Designation of work "by others", if shown in Submittals prepared by a Subcontractor, subconsultant or supplier, shall mean that work will be the responsibility of the Design Builder or another Subcontractor rather than the Subcontractor, subconsultant or supplier that has prepared submittals.

1.2.13 Prior to submitting to District, each of Design Builder's Submittals must be reviewed by the Design Build Architect and/or its Subconsultants and marked with actions defined as follows:

1.2.13.1 NO EXCEPTIONS TAKEN - Accepted subject to its compatibility with future Submittals and additional partial Submittals for portions of the Work not covered in this Submittal. Does not constitute approval or deletion of specified or required items not shown on the Submittal.

1.2.13.2 MAKE CORRECTIONS NOTED (NO RESUBMISSIONS REQUIRED) - Same as 1. above, except that minor corrections as noted shall be made by Design Builder.

1.2.13.3 AMEND AND RESUBMIT - Rejected because of major inconsistencies or errors that must be resolved or corrected by Design Builder prior to subsequent review by District.

1.2.13.4 REJECTED - RESUBMIT - Submitted material does not conform to Drawings and Specifications in major respects, e.g., wrong size, model, capacity, or material.

1.2.13.5 NOT REVIEWED - Submitted material has not been reviewed and is being returned to be acted upon by Design Builder without review by District.

1.2.13.6 DISTRICT REVIEW & ACCEPTANCE REQUIRED - Submitted material meets Design Builder's general acceptance but, constitutes a variation from the approved Contract Documents thus requiring District-specific review and acceptance. District's reviewed submittal will be returned to Design Builder with actions as defined in 1 through 5 above.

1.2.14 It shall be Design Builder's responsibility to copy, conform and distribute reviewed Submittals in sufficient numbers for Design Builder's files, Subcontractors and vendors.

1.2.15 After District's review of a Submittal, revise and resubmit as required. Identify changes made since previous Submittal.

1.2.15.1 Begin no fabrication or work that requires Submittals until return of Submittals not requiring re-submittal.

1.2.15.2 Normally, Submittals will be processed and returned to Design Builder within fifteen (15) Business Days of receipt and shall be processed by District so as not to delay Design Builder's performance.

1.2.16 Distribute copies of reviewed Submittals to concerned persons. Instruct recipients to promptly report any inability to comply with Submittals.

1.3 SCHEDULE OF SHOP DRAWING AND SAMPLE SUBMITTALS

1.3.1 Submit preliminary Schedule of Shop Drawing and Sample Submittals as required by Section 00 50 00 (Agreement).

1.3.2 The Schedule of Shop Drawing and Sample Submittals will be used by District to schedule activities relating to review of submittals that may need District approval. District will review any shop drawing or submittal that constitutes substitution of products, systems or other deviation from approved Construction Documents. Schedule of Shop Drawing and Sample Submittals shall indicate a spreading out of Submittals and early Submittals of long lead-time items and of items that require extensive review.

1.3.3 Schedule of Shop Drawing and Sample Submittals shall be reviewed by District and shall be revised and resubmitted until accepted by District.

1.4 SAFETY PLAN

1.4.1 Submit five (5) copies of a Safety Plan, compliant with Article 11 of Section 00 50 00 (Agreement), specific to this Contract to District no later than thirty (30) Days after District's approval of completed Construction Documents for either the

entire Project or the first accepted phase of work as may be defined by Design Builder.

1.4.2 One (1) copy of the accepted Safety Plan will be returned to Design Builder.

1.4.3 No on-site work shall commence until the Safety Plan has been reviewed and accepted by District. Acceptance of the Safety Plan shall not affect Design Builder's responsibilities for maintaining a safe working place and instituting safety programs in connection with project. Neither the District nor any of its representatives assume any responsibility for Design Builder's safety related obligations. Design Builder shall have sole responsibility for safety on and off the Site.

1.5 PROGRESS SCHEDULE

1.5.1 See Section 00 50 00 (Agreement) for schedule and report requirements.

1.5.2 Submit one (1) operating electronic version on compact disk and five (5) print copies of the schedule at each of the following times:

1.5.2.1 Original Project Master Schedule at least five (5) Days prior to the Design Conference or within fourteen (14) Days of Notice to Proceed, whichever is earliest.

1.5.2.2 Detailed Design Schedule at least five (5) Days prior to the Design Conference or within fourteen (14) Days of Notice to Proceed, whichever is earliest.

1.5.2.3 Detailed Construction Schedule a minimum of ten (10) Days prior to the Pre-Construction Conference outlined in Section 01 31 00 (Project Meetings) or within forty (40) Days prior to start of construction, whichever is earliest.

1.5.2.4 Construction Progress Schedule updates monthly, submitted with each Pay Application.

1.5.3 Submit copies of the reports as required by Section 00 50 00 (Agreement).

1.6 PRODUCT DATA

1.6.1 Within sixty (60) Days after District's approval of completed Construction Documents for the Project submit five (5) hard copies and one (1) electronic copy of the complete list of major products proposed for use, with name of the manufacturer, trade name, and model number for each product.

1.6.2 For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.6.3 Tabulate products by specification section number.

1.6.4 Supplemental Data:

1.6.4.1 Submit number of copies that Design Builder requires, plus five (5) hardcopies and one (1) electronic copy that will be retained by District.

1.6.4.2 Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to the Project.

1.6.5 Provide copies for Project Record Documents described in Section 01 77 00 (Cleaning and Closeout Procedures).

1.7 SHOP DRAWINGS

1.7.1 Submit electronically or in hardcopy format as approved by District. Minimum Sheet Size: 8-1/2 inches by 11 inches. All others: Multiples of 8-1/2 inches by 11 inches, 34 inches by 44 inches maximum.

1.7.2 For Shop Drawings submitted in hardcopy format, submit the number of copies which Design Builder requires, plus five (5) copies which will be retained by District.

1.7.3 For Shop Drawings submitted in hardcopy format, the original sheet will be marked with District's review comments and returned to Design Builder when required as outlined in paragraph 1.2 above.

1.7.4 Mark each copy to identify applicable products, models, options, and other data; supplement manufacturers' standard data to provide information unique to the Work.

1.7.5 Include manufacturers' installation instructions when required by Specification section.

1.8 SAMPLES

1.8.1 Submit full range of manufacturers' standard colors, textures, and patterns when District's selection is required as outlined in paragraph 1.2 above.

1.8.2 Submit samples to illustrate functional and aesthetic characteristics of each product, with integral parts and attachment devices. Coordinate Submittal of different categories for interfacing work.

1.8.3 Include identification on each sample, giving full information.

1.8.4 Submit five (5) samples unless otherwise specified.

1.8.5 Sizes: Unless otherwise specified, provide the following:

1.8.5.1 Paint Chips: Manufacturers' standard
1.8.5.2 Flat or Sheet Products: Minimum 6 inches square, maximum 12 inches square
1.8.5.3 Linear Products: Minimum 6 inches, maximum 12 inches long
1.8.5.4 Bulk Products: Minimum 1 pint, maximum 1 gallon

1.8.6 Full size samples may be used in the Work upon approval.

1.9 QUALITY CONTROL SUBMITTALS

1.9.1 Design Data: Submit electronically or in hardcopy format as approved by District. When submitted in hardcopy format, submit five (5) copies. One (1) copy shall be marked with District's review comments and returned to Design Builder when required as outlined in paragraph 1.2 above.

1.9.1.1 Indicate that the design data conforms to or exceeds the requirements of the Contract Documents.

1.9.1.2 Submit supporting reference data, affidavits, and certifications as appropriate.

1.9.1.3 Identify conflicts with test reports, certificates, manufacturer's instructions or specific aspect(s) of the Contract Documents.

1.9.2 Test Reports: Submit electronically or in hardcopy format as approved by District. When submitted in hardcopy format, submit five (5) copies. One (1) copy will be marked with District's review comments and returned to Design Builder when required as outlined in paragraph 1.2 above.

1.9.2.1 Indicate that the material or product conforms to or exceeds specified requirements.

1.9.2.2 Reports may be from recent or previous tests on material or product, but must be acceptable to District. Comply with requirements of each individual Specification.

1.9.3 Certificates: Submit electronically or in hardcopy format as approved by District. When submitted in hardcopy format, submit five (5) copies. One (1) copy will be marked with District's review comments and returned to Design Builder when required as outlined in paragraph 1.2 above.

1.9.3.1 Indicate that the material or product conforms to or exceeds specified requirements.

1.9.3.2 Submit supporting reference data, affidavits, and certifications as appropriate.

1.9.3.3 Certificates may be recent or from previous test results on material or product, but must be acceptable to District.

1.9.4 Manufacturers' Instructions: Submit electronically or in hardcopy format as approved by District. When submitted in hardcopy format, submit five (5) copies. One (1) copy will be marked with District's review comments and returned to Design Builder when required as outlined in paragraph 1.2 above.

1.9.4.1 Include manufacturers' printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing.

1.9.4.2 Identify conflicts between manufacturers' instructions and Contract Documents.

1.10 MACHINE INVENTORY SHEETS

1.10.1 Not applicable.

1.11 OPERATIONS AND MAINTENANCE MANUALS

1.11.1 Refer to Section 01 77 00 (Cleaning and Closeout Procedures) for Operation and Maintenance Manual submittal requirements.

1.12 COMPUTER PROGRAMS

1.12.1 When any equipment requires operation by computer program(s), submit a copy of the program on appropriate compact disc plus all user manuals and guides for operating the programs and making changes in the programs for upgrading and expanding the databases. Programs must be Windows XP compatible, or newer, or in a form otherwise acceptable to District. Provide required licenses to District at no additional cost.

1.13 PROJECT RECORD DOCUMENTS

1.13.1 Submit one (1) copy of each of the Project Record Documents listed in Section 01 77 00 (Cleaning and Closeout Procedures).

1.14 DELAY OF SUBMITTALS

1.14.1 Delay of Submittals by Design Builder is considered avoidable delay and Design Builder will not be entitled to an adjustment of the Contract Time due to delays attributed to late Submittals. Liquidated damages incurred because of late Submittals will be assessed to Design Builder.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

1.1 SUMMARY

1.1.1 This section includes regulatory requirements applicable to the Project.

1.1.2 Specific reference in the specifications to codes and regulations or requirements of regulatory agencies shall mean the latest printed edition of each adopted by the regulatory agency in effect at the date of award of the Design/Build Agreement, even if an earlier version was used in development of, and/or specified elsewhere in the Contract Documents, Request for Proposals or Criteria Documents.

1.1.3 Should any conditions develop not covered by the Contract Documents wherein the finished work will not comply with current codes, Design Builder shall address such conditions so that the finished work conforms to current codes.

1.2 REFERENCES TO REGULATORY REQUIREMENTS

1.2.1 Codes, laws, ordinances, rules and regulations referred to in the Contract Documents shall have full force and effect as though printed in full in these specifications. Codes, laws, ordinances, rules and regulations are not furnished to the Design Builder, because the Design Builder is assumed to be familiar with their requirements. The listing herein of applicable codes, laws and regulations, including those for hazardous waste abatement work, in the Contract Documents is supplied to the Design Builder as a courtesy and shall not limit the Design Builder's responsibility for complying with all applicable laws, regulations or ordinances applicable to the Work. Where conflict among the requirements or with these specifications exists, the most stringent requirements shall be used.

1.2.2 All of the Work shall conform to all applicable Federal, State, and local codes, laws, ordinances, rules and regulations.

1.2.3 Precedence:

1.2.3.1 Where specified requirements differ from the requirements of applicable codes, ordinances and standards, the more stringent requirements shall take precedence.

1.2.3.2 Where the Drawings, Plans or Specifications require or describe products or execution of better quality, higher standard or greater size than required by applicable codes, ordinances and standards, the Drawings, Plans and Specifications shall take precedence so long as such increase is legal.

1.2.3.3 Where no requirements are identified in the Drawings, Plans or Specifications, Design Builder shall comply with all requirements of

applicable codes, ordinances and standards of governing authorities having jurisdiction.

1.2.3.4 The 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 proposals are opened and as it pertains to school construction including, without limitation:

1.2.3.4.1 Test and testing laboratory per section 4-335.

1.2.3.4.2 Special inspections per section 4-333 ©

1.2.3.4.3 Verified reports per section 4-365 & 4-343 ©

1.2.3.4.4 Duties of the Architect and Engineers shall be per section 4-333 (a) and 4-341.

1.2.3.4.5 Duties of the Design Builder shall be per section 4-343.

1.2.3.4.6 Addenda and Change Orders per section 4-338.

1.3 CODES

1.3.1 Codes which apply to the Contract Documents include, but are not limited to, the following:

1.3.1.1 California Building Code (Title 15, Part 2, Title 24, C.C.R., including, without means of limitation, sections 16A, 102A.23, 308, 420A, 504-506, 904.2.6, 1019 and 1604)

1.3.1.2 California Electrical Code (Part 5, Title 24, C.C.R.)
1.3.1.3 California Mechanical Code (Part 3, Title 24, C.C.R.)
1.3.1.4 California Plumbing Code (Part 4, Title 24, C.C.R)
1.3.1.5 California Elevator Safety Regulations (Part 7, Title 24, C.C.R.)
1.3.1.6 International Building Code
1.3.1.7 Uniform Plumbing Code
1.3.1.8 Uniform Mechanical Code
1.3.1.9 National Electrical Code
1.3.1.10 California Energy Code
1.3.1.11 California Fire Code

1.3.1.12 1.3.1.12 CALGreen Code

1.4 LAWS, ORDINANCES, RULES AND REGULATIONS

1.4.1 During prosecution of Work to be done under the Contract Documents, comply with applicable laws, ordinances, rules and regulations, including, but not limited to, the following:

1.4.2 Federal

1.4.2.1 Americans With Disabilities Act of 1990 CADAI
1.4.2.2 29 CFR, Section 1910.1001, Asbestos
1.4.2.3 40 CFR, Subpart M, National Emission Standards for Asbestos
1.4.2.4 Executive Order 11246
1.4.2.5 Federal Endangered Species Act
1.4.2.6 Clean Water Act
1.4.2.7 Federal Occupational Safety & Health Administration Act

1.4.3 State of California

1.4.3.1 California Code of Regulations, Titles 5, 8, 12, 13, 15, 17, 19, 20, 21, 22, 23 24 and 25

1.4.3.2 California Public Contract Code

1.4.3.3 California Health and Safety Code

1.4.3.4 California Government Code

1.4.3.5 California Labor Code

1.4.3.6 California Civil Code

1.4.3.7 California Code of Civil Procedure

1.4.3.8 CPUC General Order 95, Rules for Overhead Electric Line Construction

1.4.3.9 CPUC General Order 128, Rules for Construction of Underground Electric Supply and Communications Systems

1.4.3.10 California Occupational Safety and Health Administration (Cal OSHA)

1.4.3.11 Occupational Safety and Health Administration (OSHA): Hazard Communications Standards

1.4.3.12 California Endangered Species Act

1.4.3.13 Water Code

1.4.3.14 Fish and Game Code

1.4.3.15 California Education Code

1.4.4 State of California Agencies

1.4.4.1 State and Consumer Services Agency
1.4.4.2 Office of the State Fire Marshal
1.4.4.3 CalTrans

1.4.4.4 Department of Fish and Game
1.4.4.5 Division of the State Architect
1.4.4.6 Office of Public School Construction
1.4.4.7 State Allocation Board
1.4.4.8 California Department of Education

1.4.5 Local Agencies:

1.4.5.1 City of Oakland
1.4.5.2 City of Oakland Fire Marshal
1.4.5.3 Bay Area Air Quality Management District
1.4.5.4 EBMUD – East Bay Municipal Utility District

1.4.6 Other Requirements:

1.4.6.1 National Fire Protec tion Association (NFPA): Pamphlet 101, Life Safety.

1.4.6.2 The following NFPA Standards apply (latest edition):

NFPA Standard
13 Installation of Sprinkler Systems
14 Installation of Standpipes and Hose Systems
20 Installation of Centrifugal Fire Pumps
24 Installation of Private Fire Service Mains
50 Bulk Oxygen Systems
72 National Fire Alarm Code (as amended)
80 Fire Doors and Fire Windows
92A Smoke Control Systems
2001 Clean Agent Fire Extinguishing Systems

1.4.6.3 The Design Builder shall comply with Standard Specifications such as California Standard Specification, ASTM, ANSI, AASHTO, AISC, Commercial Standards, Federal Specifications, NFPA, NEMA, AWWA, UL, and the like.

1.4.6.4 References on the Drawings Plans or in the Specifications to “code” or “building code” not otherwise identified shall mean the codes specified in this Section 01 41 00 together with all additions, amendments, changes, and interpretations adopted by code authorities of the jurisdiction.

1.4.7 Design Builder shall provide access to all of the foregoing within twenty-four (24) hours and maintain a copy of each of the above documents in the Design Builder’s field office.

1.4.8 It shall be understood that manufacturers, producers, and their agents of materials are required either to have such specifications available for reference or to be fully familiar with their requirements as pertains to their project or material

1.4.9 Other Applicable Laws, Ordinances and Regulations:

1.4.9.1 Work shall be accomplished in conformance with all applicable laws, ordinances, rules and regulations of Federal, State and local governmental agencies and jurisdictions having authority over the Project.

1.4.9.2 Work shall be accomplished in conformance with all rules and regulations of public utilities and utility districts.

1.4.9.3 Where such laws, ordinances rules and regulations require more care or greater time to accomplish Work, or require better quality, higher standards or greater size of products, Work shall be accomplished in conformance to such requirements with no change to the Contract Time and Stipulated Sum.

1.4.10 Change Orders and Claims:

1.4.10.1 The Public Contract Code, including but not limited to § 7105(d)(2), and Government Code § 930.2 *et seq*., apply to all contract procedures for changes, time extensions, change orders (time or compensation) and claims.

1.4.10.2 Any change, waiver, or omission to implement contract change order and claim procedures shall have no legal effect unless expressly authorized in a fully executed change order approved by District.

1.5 DEFERRED APPROVAL

1.5.1 Where noted in technical Specification sections, certain items of material may require deferred approval pending submittal of shop drawings. It is the District's intent to minimize the number of deferred submittals for this project. For these items, Contractor shall submit details and structural calculations for anchorage, to comply with State of California Code of Regulations Title 24, including Table 16-B. Calculations shall be made by a Structural Engineer registered in the State of California.

1.6 CONFLICTS

1.6.1 Between referenced regulatory requirements: Comply with the one establishing the more stringent requirement.

1.6.2 Between referenced regulatory requirements and the Contract Documents: Comply with the one establishing the more stringent requirement.

1.7 COMPLIANCE WITH AMERICANS WITH DISABILITIES ACT

1.7.1 The Design Builder acknowledges that, pursuant to the Americans with Disabilities Act (ADA), programs, services and other activities provided by a public entity to the public, whether directly or through a Design Builder, must be

accessible to the disabled public. The Design Builder shall provide the services specified in this Agreement in a manner that complies with the ADA and any and all other applicable federal, state and local disability rights legislation. The Design Builder shall not discriminate against disabled persons in the provision of services, benefits or activities provided under this Agreement and further agrees that any violation of this prohibition on the part of the Design Builder, its employees, agents or assigns shall constitute a material breach of this Agreement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

1.1 SUMMARY

1.1.1 This section includes reference standards, abbreviations, symbols and definitions used in the Contract Documents.

1.1.2 Material and workmanship specified by reference to number, symbol, or title of specific standard such as state standard, commercial standard, federal specifications, technical society, or trade association standard, or other similar standard shall comply with requirements of standards except when more rigid requirements are specified or required by applicable codes.

1.1.3 Standards referred to, except as modified herein, shall have full force and effect as though printed in the Contract Documents. Standards are not furnished to the Design Builder, since manufacturers and trades involved are assumed to be familiar with their requirements.

1.2 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES; REPORTING AND RESOLVING DISCREPANCIES

1.2.1 References to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code, or laws or regulations in effect at the time of opening of Proposals, except as may be otherwise specifically stated in the Contract Documents.

1.2.2 If during the performance of the Work, Design Builder discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such law or regulation applicable to the performance of the Work or of any such standard, specification, manual, or code or of any instruction of any supplier, report it in writing at once by submitting an RFI to District, and await District's instructions before proceeding.

1.2.3 Except as otherwise specifically stated in the Contract Documents or as may be provided by Change Order, RFP, CCD, or Supplemental Instruction, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

1.2.3.1 The provisions of any such standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

1.2.3.2 The provisions of any such laws or regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such law or regulation).

1.2.4 No provision of any such standard, specification, manual, code, or instruction shall be effective to change the duties and responsibilities of District or Design Builder or any of Design Builder's consultants, agents, or employees, from those set forth in the Contract Documents, nor shall it be effective to assign to District or any of its consultants, agents, representatives or employees any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

1.2.5 Comply with the applicable portions of standards and specifications published by the technical societies, institutions, associations, and governmental agencies referred to in the Contract Documents.

1.2.5.1 Comply with referenced standards and specifications; latest revision in effect at the time of opening of Proposals, unless otherwise identified by date.

1.2.5.1.1 Exception: Comply with issues in effect as listed in governing legal requirements.

1.2.6 Referenced Grades, Classes, and Types: Where an alternative or optional grade, class, or type of product or execution is included in a reference but is not identified in Drawings or in Specifications, provide the highest, best, and greatest of the alternatives or options for the intended use and prevailing conditions.

1.2.7 Jobsite Copies:

1.2.7.1 Obtain and maintain at the Site copies of reference standards identified on Drawings and in Specifications in order to properly execute the Work.

1.2.7.2 At a minimum, the following shall be readily available at the Site:

1.2.7.2.1 Safety Codes: State of California, Division of Industrial Safety regulations.

1.2.8 Edition Date of References:

1.2.8.1 When an edition or effective date of a reference is not given, it shall be understood to be the current edition or latest revision published as of the date of opening Proposals.

1.2.8.2 All amendments, changes, errata and supplements as of the effective date shall be included.

1.2.9 ASTM and ANSI References: Specifications and Standards of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI) are identified in the Drawings and Specifications by abbreviation and number only and may not be further identified by title, date, revision, or

amendment. It is presumed that Design Builder is familiar with and has access to these nationally- and industry-recognized specifications and standards.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

1.1 SUMMARY

1.1.1 This section includes reference standards, abbreviations, symbols and definitions used in the Contract Documents.

1.1.2 Material and workmanship specified by reference to number, symbol, or title of specific standard such as state standard, commercial standard, federal specifications, technical society, or trade association standard, or other similar standard shall comply with requirements of standards except when more rigid requirements are specified or required by applicable codes.

1.1.3 Standards referred to, except as modified herein, shall have full force and effect as though printed in the Contract Documents. Standards are not furnished to the Design Builder, since manufacturers and trades involved are assumed to be familiar with their requirements.

1.2 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES; REPORTING AND RESOLVING DISCREPANCIES

1.2.1 References to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code, or laws or regulations in effect at the time of opening of Proposals, except as may be otherwise specifically stated in the Contract Documents.

1.2.2 If during the performance of the Work, Design Builder discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such law or regulation applicable to the performance of the Work or of any such standard, specification, manual, or code or of any instruction of any supplier, report it in writing at once by submitting an RFI to District, and await District's instructions before proceeding.

1.2.3 Except as otherwise specifically stated in the Contract Documents or as may be provided by Change Order, RFP, CCD, or Supplemental Instruction, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

1.2.3.1 The provisions of any such standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

1.2.3.2 The provisions of any such laws or regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such law or regulation).

1.2.4 No provision of any such standard, specification, manual, code, or instruction shall be effective to change the duties and responsibilities of District or Design Builder or any of Design Builder's consultants, agents, or employees, from those set forth in the Contract Documents, nor shall it be effective to assign to District or any of its consultants, agents, representatives or employees any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

1.2.5 Comply with the applicable portions of standards and specifications published by the technical societies, institutions, associations, and governmental agencies referred to in the Contract Documents.

1.2.5.1 Comply with referenced standards and specifications; latest revision in effect at the time of opening of Proposals, unless otherwise identified by date.

1.2.5.1.1 Exception: Comply with issues in effect as listed in governing legal requirements.

1.2.6 Referenced Grades, Classes, and Types: Where an alternative or optional grade, class, or type of product or execution is included in a reference but is not identified in Drawings or in Specifications, provide the highest, best, and greatest of the alternatives or options for the intended use and prevailing conditions.

1.2.7 Jobsite Copies:

1.2.7.1 Obtain and maintain at the Site copies of reference standards identified on Drawings and in Specifications in order to properly execute the Work.

1.2.7.2 At a minimum, the following shall be readily available at the Site:

1.2.7.2.1 Safety Codes: State of California, Division of Industrial Safety regulations.

1.2.8 Edition Date of References:

1.2.8.1 When an edition or effective date of a reference is not given, it shall be understood to be the current edition or latest revision published as of the date of opening Proposals.

1.2.8.2 All amendments, changes, errata and supplements as of the effective date shall be included.

1.2.9 ASTM and ANSI References: Specifications and Standards of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI) are identified in the Drawings and Specifications by abbreviation and number only and may not be further identified by title, date, revision, or

amendment. It is presumed that Design Builder is familiar with and has access to these nationally- and industry-recognized specifications and standards.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

1.1.1 This Section includes administrative and procedural requirements for the following:

1.1.1.1 Quality assurance and quality control.

1.1.1.2 Quality Control Plan.

1.1.1.3 Special testing and inspection.

1.1.2 Materials to be furnished under the Contract Documents are subject to testing and inspection for compliance with the Drawings and Specifications. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Design Builder of responsibility for compliance with the Contract Document requirements.

1.1.2.1 Specific quality assurance and control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

1.1.2.2 Specified tests, inspections, and related actions do not limit Design Builder's other quality assurance and control procedures that facilitate compliance with the Contract Document requirements.

1.1.2.3 Requirements for Design Builder to provide quality assurance and control services required by District are not limited by provisions of this Section.

1.1.3 Related Sections include the following:

1.1.3.1 Section 00 50 00 (Agreement) for developing a schedule of required tests and inspections.

1.1.3.2 Section 01 43 39 (Mock-Ups) for the specific quality requirements associated with the construction and inspection of mock-ups.

1.1.3.3 Section 01 73 29 (Cutting and Patching) for repair and restoration of construction disturbed by testing and inspecting activities.

1.1.3.4 Divisions 2 through 33 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

1.2.1 Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

1.2.2 Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by District's Representative.

1.2.3 NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.

1.2.4 NVLAP: A testing agency accredited according to the National Institute of Standards and Technology's (NIST's) National Voluntary Laboratory Accreditation Program.

1.2.5 Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

1.2.6 Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to District's Representative, to establish product performance and compliance with industry standards.

1.2.7 Source Quality Control Testing: Tests and inspections that are performed at the source (i.e., a plant, mill, factory, or shop).

1.2.8 Field Quality Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

1.2.9 Testing Agency: An entity engaged to perform specific tests, inspections, or both that is certified as meeting the requirements applicable to the Work. Testing laboratory shall mean the same as testing agency.

1.2.10 Testing, Inspection and Observation (TIO) Program: A program prepared for approval prior to issuance of the building permit that identifies the materials and tests to be performed on a project and the firm(s) and/or individual(s) responsible for performing those tests including, at a minimum, those required by applicable sections of the California Building Standards Code.

1.2.11 Installer/Applicator/Erector: Design Builder or another entity engaged by Design Builder as an employee or Subcontractor of any tier to perform a particular construction operation, including installation, erection, application, and similar operations.

1.2.12 Experienced: As used herein, an individual or entity that has successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction to work in California.

1.3 CONFLICTING REQUIREMENTS

1.3.1 General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to District's Representative for a decision before proceeding.

1.3.2 Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to District's Representative for a decision before proceeding.

1.4 QUALITY CONTROL PERSONNEL

1.4.1 Quality Control Manager: Provide a Quality Control Manager at the Site to manage and implement the Quality Control Plan. The duties and responsibilities of the Quality Control Manager will be to manage and implement the Quality Control Plan. The Quality Control Manager's duties and responsibilities include, but are not limited to:

1.4.1.1 Attending the Coordination and Detailing Activity (CDA) meetings, Weekly Construction Progress Meetings, Pre-installation Meetings, and Commissioning Meetings.

1.4.1.2 Conducting Quality Control meetings, as necessary.

1.4.1.3 Reviewing submittals.

1.4.1.4 Preparing, monitoring and following through on Requests for Information, Change Orders, and Deferred Approvals.

1.4.1.5 Preparing, coordinating and following through on Requests for Inspection.

1.4.1.6 Ensuring testing is performed.

1.4.1.7 Preparing required Quality Control certifications and documentation.

No Work or testing may be performed unless the Quality Control Manager or a Designated Alternate Quality Control Manager is on the Site. The Quality Control Manager shall report directly to an officer of the Design Build firm who shall not be the same individual as, nor be subordinate to, the Project Manager or Superintendent.

1.4.2 Qualifications: The Quality Control Manager must be a graduate of a four year accredited college program in one of the following disciplines: engineering,

architecture, construction management, engineering technology, building construction, or building science with a minimum of ten (10) years' experience as a superintendent, inspector, Quality Control Manager, project manager, or construction manager on major and complex projects.

1.4.3 Other Quality Control Personnel: Provide additional quality control personnel (e.g., Quality Control Specialists, administrative support staff) as described in the Quality Control Plan and as required to implement the Quality Control Plan. The District, at its sole discretion, may require the Design Builder to assign additional quality control personnel to the Project if the District believes the Design Builder's assigned personnel are not capable of implementing the Quality Control Plan to the District's satisfaction. The Design Builder shall provide any additional personnel required by the District at no additional cost. Other active members of the Quality Control Program shall include a minimum of a full time architectural and engineering coordinator, Contractor's LEED Coordinator as defined in Section 01 81 13 (Sustainable Design Requirements, and Contractor's Commissioning Coordinator as defined in Section 01 81 00 (Commissioning Requirements). The Quality Control Manager and supporting members' responsibility is to ensure compliance with Contract Documents and is a requirement of the Contractor Quality Control Program.

1.5 SUBMITTALS

1.5.1 Qualification Data: For testing agencies specified in Article 1.6 (Quality Assurance) below to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.5.1.1 Testing, Inspection and Observation Program: Prepare according to the requirements contained in Section 7-141 of the California Building Standards Administrative Code (Part 1, Title 24, CCR). Submit to District Representative for approval prior to issuance of the building permit.

1.5.2 Reports: Reports of all tests made shall be provided regardless of whether test results indicate that the material tested is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Prepare and submit certified written reports that include the following:

1.5.2.1 Date of issue.

1.5.2.2 District's Project title and number.

1.5.2.3 Name, address, and telephone number of testing agency.

1.5.2.4 Dates and locations of samples and tests or inspections.

1.5.2.5 Applicable Construction Drawing, detail, and Specification numbers.

1.5.2.6 Names of individuals making tests and inspections.

1.5.2.7 Description of the Work and test and inspection method.

1.5.2.8 Identification of product and Specification Section including specified design strength or other applicable criteria.

1.5.2.9 Complete test or inspection data.

1.5.2.10 Test and inspection results and an interpretation of test results.

1.5.2.11 Record of temperature and weather conditions at time of sample taking and testing and inspecting.

1.5.2.12 Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.

1.5.2.13 A statement that the material or materials were sampled and tested according to the requirements of the California Code of Regulations, Title 21 or 22 and 24.

1.5.2.14 Name and signature of laboratory inspector.

1.5.2.15 Recommendations on retesting and reinspecting, if any.

1.5.2.16 Reports shall be prepared according to the requirements of a Testing, Inspection, and Observation Program ("TIO") and sections 7-141 and 7-151 of the California Building Standards Code, Part 1, Title 24, CCR. Copies of each report shall be submitted as follows:

1.5.2.16.1 District Representative
1.5.2.16.2 Architect of Record
1.5.2.16.3 Structural Engineer of Record
1.5.2.16.4 Design Builder (2 copies)
1.5.2.16.5 Inspector of Record

1.5.3 Permits, Licenses, and Certificates: For District's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.5.4 Quality Control Plan: Prepare a plan describing procedures and methods the Design Builder will utilize to control the quality of the Work. At a minimum the Quality Control Plan shall include:

1.5.4.1 An organizational structure description, including Quality Control supervision, and inspection reporting structure. Delineate personnel training and qualification activities.

1.5.4.2 Plans and procedures for testing and inspections to verify attributes delineated in the Contract Documents, including those specified in

referenced Codes and standards. Include documents that identify individual inspection or testing points and acceptance criteria, and include provisions for recording results and the responsible inspection/test personnel. This documentation shall be traceable to the particular material, items, processes or systems evaluated, including notification requirements.

1.5.4.3 Procedures for identifying and contractually invoking the applicable technical and quality requirements delineated in the Specifications on vendors supplying materials, parts and services.

1.5.4.4 Plans and procedures for receiving, inspecting and accepting materials and items. These shall include examination of physical condition and compliance with purchasing requirements, including markings for class type and grade, and conformance with supplied documentation. These shall also include provisions for:

1.5.4.4.1 Identifying, controlling and processing non-conforming items, including notification to the District.

1.5.4.4.2 Inspection of materials for authenticity to preclude counterfeit parts, for items and attributes of concern identified by District.

1.5.4.4.3 Verifying for compliance and traceability, maintaining, and turnover to the District, certificates of conformance and mill certificates required by Contract Documents or codes or standards invoked, for materials received.

1.5.4.5 Provisions for identifying defective Work. Bring to District's attention, for consultation and possible relief, those cases where correction within the specified requirements may introduce a significant schedule penalty, personnel hazard, or compromise the quality of installed items, or is otherwise impractical.

1.5.4.6 Controls to assure that only the "Approved for Inspection" construction documents are utilized in the Work.

1.5.4.6.1 This includes provisions for removing superseded versions from the work area, except where explicitly and prominently marked "Void - For Information Only"; such as to retain annotated installation data.

1.5.4.7 Detailed formal procedures or instructions for the performance of special processes, such as welding or concrete placement. These procedures/instructions and personnel performing special processes shall be qualified and certified as required by codes and standards invoked in the Contract Documents.

1.5.4.8 Controls providing for periodic calibration of testing and measurement equipment, including unique equipment identification and calibration tracking.

1.5.4.9 Maintain records documenting the implementation of the above activities, including tests, inspections, special process qualification and execution, vendor documentation and defective Work resolution. These records shall be indexed, protected and retrievable for final submission to District.

1.5.4.10 Identify all tests and inspections that Design Builder proposes to be conducted by the District.

1.5.4.11 Approval: The Quality Control Plan must be approved before the start of construction and shall reflect the requirements of the approved Testing, Inspection and Observation Program. The District reserves the right to require revisions to the Quality Control Plan that are necessary to ensure the specified quality of the Work. The District may interview Quality Control personnel at any time to verify their submitted qualifications.

1.5.4.12 Changes: The Design Builder shall submit any requested changes to the Quality Control Plan, including changes in personnel, to the District in writing. Proposed changes must be submitted at least seven (7) Days in advance of the desired effective date of the change. No change in the Quality Control Plan shall be implemented without the District Representative's written approval.

1.6 QUALITY ASSURANCE

1.6.1 General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

1.6.2 Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance. Installers shall be qualified by the product or equipment manufacturer, if required for warranty or other performance guarantees.

1.6.3 Manufacturer Qualifications: A firm experienced in fabricating products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units as required to meet the Project schedule.

1.6.4 Fabricator Qualifications: A firm experienced in procuring and fabricating products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units as required to meet the Project schedule.

1.6.5 Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of systems, assemblies, or products that are similar to those indicated for this Project in material, design, and extent.

1.6.6 Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1.6.6.1 Requirement for specialists shall not supersede building codes and regulations governing the Work.

1.6.7 Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, including the requirements of ASTM D3666, D3740, E329, E543, and E548 as applicable; and with additional qualifications specified in individual Sections; and that is acceptable to District. All testing shall be performed under the supervision and control of a California registered professional engineer employed by the testing agency.

1.6.8 Factory-Authorized Service Representative Qualifications: An authorized representative of a manufacturer who is trained and approved by the manufacturer to inspect installation of the manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.6.9 Preconstruction Testing: Where a testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1.6.9.1 Design Builder's responsibilities include the following:

1.6.9.1.1 Provide test specimens representative of proposed products and construction.

1.6.9.1.2 Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

1.6.9.1.3 Provide sizes and configurations of test assemblies to adequately demonstrate capability of products to comply with performance requirements.

1.6.9.1.4 Build site-assembled test assemblies using installers who will perform same tasks for Project.

1.6.9.1.5 When testing is complete, remove test specimens and assemblies; do not reuse products on Project.

1.6.9.2 Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality assurance service to Design Builder, with a copy to the District. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

1.7.1 District Responsibilities: Where quality control services are indicated as District's responsibility, District will engage a qualified testing agency to perform these services.

1.7.1.1 Specified inspection and testing shall be performed in accordance with Part 1, Title 24, Article 4, Paragraph 7-149, California Code of Regulations.

1.7.1.2 District will furnish Design Builder with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspections they are engaged to perform.

1.7.1.3 Payment for these services will be by the District.

1.7.1.4 Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Design Builder, and the Contract Sum will be adjusted by Change Order.

1.7.1.5 District's Project Inspector:

1.7.1.5.1 A Project Inspector employed by the District in accordance with the requirements of the California Building Code will be assigned to the work. The Project Inspector's duties are specifically defined in CCR Title 24 Part 1.

1.7.1.5.2 The Design Builder shall notify the Project Inspector a minimum of 2 working days in advance of execution of all Work that requires inspection.

1.7.1.5.3 The Work in all stages of progress shall be subject to the personal continuous observation of the Project Inspector. He or she shall have free and safe access to any or all parts of the work at any time. The Design Builder shall furnish the Project Inspector reasonable facilities for obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the work and the character of the materials. Inspection of the work shall not relieve the Design Builder from any obligation to fulfill this Contract.

1.7.2 Design Builder's Responsibilities: Tests and inspections not explicitly assigned to District are Design Builder's responsibility

1.7.2.1 Where services are indicated as Design Builder's responsibility, engage a qualified testing agency to perform these quality control services.

1.7.2.1.1 Design Builder shall not employ same entity engaged by District.

1.7.2.2 Notify testing agencies and the District Representative at least seventy-two (72) hours in advance of time when Work that requires testing or inspecting will be performed.

1.7.2.3 Where quality control services are indicated as Design Builder's responsibility, submit a certified written report, in duplicate, of each quality control service to the District Representative.

1.7.2.4 Testing and inspecting requested by Design Builder and not required by the Contract Documents are Design Builder's responsibility.

1.7.2.5 Submit additional copies of each written report directly to authorities having jurisdiction, when so directed by the District Representative.

1.7.2.6 Do not cover work before required tests and inspections are performed (refer to paragraphs 4.22 and 4.1 of section 00 50 00 (Agreement)).

1.7.3 Disqualified Material: Material shipped or delivered to the site by the Design Builder from the source of supply prior to satisfactorily passing required tests or inspections, or prior to the receipt of a notice from the District Representative that such testing or inspection is not required, shall not be incorporated into the Work.

1.7.4 Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 (Submittal Procedures).

1.7.5 Retesting/Reinspecting: Regardless of whether original tests or inspections were Design Builder's responsibility, provide quality control services, including retesting and reinspection, for construction that replaces Work that failed to comply with the Contract Documents (refer to paragraphs 4.22 of section 00 50 00 (Agreement)).

1.7.5.1 If such additional tests or inspections establish that such portion of the Work fails to comply with the Contract Documents, all costs of such additional tests and inspections, and all other costs resulting from such failure, including compensation for District Representative and District's consultants shall be deducted from the Contract Sum by Change Order.

1.7.5.2 In addition, the Design Builder shall pay for:

1.7.5.2.1 Additional costs, including compensation for travel and daily living expenses that are beyond normal inspection costs, when the District's Testing Laboratory is required to conduct inspections outside of the San Francisco Bay area.

1.7.5.2.2 Costs of retesting Work revised or replaced by Design Builder, where required tests were performed on original construction.

1.7.5.2.3 Costs of retesting construction used as temporary facilities by the Design Builder.

1.7.5.2.4 Costs of testing construction required by Design Builder's substitutions.

1.7.6 Testing Agency Responsibilities: Cooperate with District Representative and Design Builder in performance of duties. Provide qualified personnel to perform required tests and inspections:

1.7.6.1 Notify District Representative and Design Builder promptly of irregularities or deficiencies observed in the Work during performance of services.

1.7.6.2 Determine the location(s) from which test samples will be taken and in which in-situ tests are conducted.

1.7.6.3 Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

1.7.6.4 Submit a certified written report, in duplicate, of each test, inspection, and similar quality control service through Design Builder.

1.7.6.5 Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

1.7.6.6 Do not perform any duties of Design Builder.

1.7.6.7 Submit two copies of a verified report to District Representative covering all tests and inspections that are required by the TIO Program during the progress of the Work. The report shall be furnished each time that the Work is suspended, covering the tests completed up to that time, at the completion of the Work, covering all tests, and as otherwise required by the TIO Program.

1.7.7 Associated Services: The Design Builder shall cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1.7.7.1 Access to the Work.

1.7.7.2 Incidental labor and facilities necessary to facilitate tests and inspections.

1.7.7.3 Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

1.7.7.4 Facilities for storage and field curing of test samples.

1.7.7.5 Delivery of specified quantities of representative samples of materials proposed for use as specified to testing agencies.

1.7.7.6 Preliminary design mix proposed for use for material mixes that require control by testing agency.

1.7.7.7 Security and protection for samples and for testing and inspecting equipment at Site.

1.7.7.8 Pursuant to paragraph 13.2.2 of section 00 50 00 (Form of Agreement), the Design/Builder will be responsible for all inspection, review, and permit costs.

1.7.8 Coordination: Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid the need to remove and replace construction to accommodate testing and inspecting.

1.7.8.1 Schedule times for tests, inspections, obtaining samples, and similar activities.

1.7.8.2 Do not cover any piping, wiring, ducts, or other installations until they have been inspected by the District's Inspector.

1.8 SPECIAL TESTS AND INSPECTIONS

1.8.1 Special Tests and Inspections: The District will engage a qualified special inspector to conduct special tests and inspections as required by law, or regulatory agencies having jurisdiction over the Work. The responsibilities of the Special Inspector are as follows:

1.8.2 Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.

1.8.3 Notifying County's Representative promptly of irregularities and deficiencies observed in the Work during performance of its services.

1.8.4 Submitting a certified written report of each test, inspection, and similar quality control service to County's Representative with copy to Design Builder.

1.8.5 Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.

1.8.6 Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.8.7 Retesting and re-inspecting corrected work, as needed.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.1 INSPECTION

3.1.1 The Design Builder shall provide access to the Work, including the facilities where the Work is in preparation, at all times for the purpose of inspection. The Design Builder shall maintain proper facilities and provide safe access for such inspection at all times.

3.1.2 The District shall have the right to reject materials and workmanship that are defective, or to require their correction. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the Site without charge to the District.

3.1.3 The District may make an examination of work already completed by requiring the Design Builder to remove or tear out such work at any time before final acceptance of the Work. Upon request, the Design Builder shall provide all facilities, labor and materials necessary to remove the portion of the Work designated by the District's Representative. If such work is found to be defective in any respect due to the fault of the Design Builder or its subcontractors, the Design Builder shall be responsible for all expenses of such examination and satisfactory reconstruction. If such work is found to meet the requirements of the Contract Documents, the additional cost of labor and materials involved in the examination shall be allowed to the Design Builder.

3.2 QUALITY CONTROL REPORTS

3.2.1 Frequency: Reports are required for each day that Work is performed, for every seven (7) consecutive Days of no work, and on the last day of a no-work period. Account for each day throughout the life of the Contract. The reporting of Work shall be identified by Specification number and title and terminology consistent with the Contract Schedule. Design Builder Quality Control Reports shall be prepared, signed and dated by the Quality Control Manager and shall contain the following information:

3.2.1.1 Identify the part or parts of the Work that is the subject of the report.

3.2.1.2 Indicate, as applicable, that for the portion of the Work, the drawings and specifications were reviewed, submittals were approved, materials comply with approved submittals, materials are stored properly,

preliminary work was done correctly, the testing plan was reviewed, and work methods and schedule were discussed.

3.2.1.3 Indicate, as applicable, that for this portion of the Work, the preliminary work was done correctly, samples have been prepared and approved, the workmanship is satisfactory, test results are acceptable, work is in compliance with the Contract Documents, and the required testing has been performed. Include a list of who performed the tests.

3.2.1.4 Results of off-site quality control work, if applicable, including actions taken.

3.2.1.5 List any rework items identified but not corrected by close of business.

3.2.1.6 List the rework items corrected from the rework items list along with the corrective action taken.

3.2.1.7 Include a "Comments" section in the report that contains pertinent information including directions received, quality control problem areas, deviations from the Quality Control Plan, construction deficiencies encountered, Quality Control meetings held, acknowledgement that as-built drawings have been updated, corrective direction given by the Quality Control Manager, and corrective action taken by the Design Builder.

3.3 TEST AND INSPECTION LOG

3.3.1 Prepare a sequentially numbered record of tests and inspection. Include the following:

3.3.1.1 Request for Inspection

3.3.1.2 Date test or inspection was conducted.

3.3.1.3 Description of the Work tested or inspected.

3.3.1.4 Applicable Construction Drawing and Specification numbers

3.3.1.5 Date test or inspection results were transmitted to District's Representative.

3.3.1.6 Identification of testing agency or special inspector conducting test or inspection.

3.3.2 Maintain log at Site. Post changes and modifications as they occur. Provide access to test and inspection log for District and its representatives' reference during normal working hours.

3.4 REPAIR AND PROTECTION

3.4.1 General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

3.4.1.1 Comply with the Contract Document requirements for Section 01 73 00 (Cutting and Patching).

3.4.2 Protect construction exposed by or for quality control service activities.

3.4.3 Repair and protection are Design Builder's responsibility, regardless of the assignment of responsibility for quality control services.

3.5 GEOTECHNICAL ENGINEERING

3.5.1 The Design Builder's geotechnical engineer or his representative will provide the following tests and inspections:

3.5.1.1 Continuous inspection of full placement

3.5.1.2 Evaluation of onsite and imported earth materials before placement.

3.5.1.3 Field test fill and earth backfill as placed and compacted.

3.5.1.4 Inspect excavations and subgrade before concrete is placed

3.5.1.5 Provide continuous inspection of pile boring.

3.5.1.6 Provide periodic inspection of open excavations, embankments, and other cuts or vertical surfaces of earth.

3.5.1.7 The Geotechnical Engineer will submit reports of tests and inspections. These reports will indicate compliance or noncompliance with the Contract Documents, results of compaction tests and that soil conditions encountered do or do not confirm anticipated conditions and support their design recommendations.

3.5.2 Design Builder shall remove unsatisfactory material, re-compact, adjust moisture, place new material, or in the case of excavations, provide proper protective measures, perform other operations necessary, as determined by the geotechnical engineer and directed by the District Representative, whose decisions and directions will be considered final.

3.5.3 Soils Test and Inspection Procedure

3.5.3.1 Allow sufficient time for testing and evaluation of results before material is needed. The Geotechnical Engineer will be the sole and final judge of suitability of all materials.

3.5.3.2 Laboratory compaction tests to be used will be in accordance with ASTM D 1557.

3.5.3.3 Field density tests will be made in accordance with ASTM D 1556.

3.5.3.4 The number of tests will be determined by the Geotechnical Engineer and District's Representative. Materials in question may not be used, pending test results.

3.5.3.5 The Geotechnical Engineer will visually or otherwise examine excavations and embankments.

3.6 CONCRETE TESTS AND INSPECTIONS

3.6.1 Tests

3.6.1.1 Notify Architect, District's Representative and testing agency of brand and type of cement and sources of aggregates in time for review, sampling and testing. Test cement in accordance with Title 24, 1928 B.1

3.6.1.2 Aggregate: The District's testing agency will test at least one sample for every two hundred (200) cubic yards of aggregate. Aggregates from a known source of supply that have shown by actual service to produce concrete of the required quality will be tested only for gradation and deleterious substances.

3.6.1.3 Obtain at least one set of samples for strength tests of each separate design mix of concrete placed each day. Frequency of sampling shall be not less than once per day, nor less than once for each fifty (50) cubic yards of concrete, nor less than once per 2,000 square feet of surface area for slabs or walls. Obtain one additional set of samples for testing at the start of concrete for each class of concrete, and whenever the mix or aggregate is changed.

3.6.1.4 One set of samples consists of four cylinders.

3.6.1.5 Cylinders will be taken so as to represent as nearly as possible the batch of concrete from which they are taken. Sampling procedures shall conform to ASTM C 172.

3.6.1.6 Test cylinders shall be made and cured in compliance with ASTM C 31, except as modified hereinafter. Tests will comply with ACI 301 for strength, slump, and air entrainment tests.

3.6.1.7 Test cylinders from respective batches, one at age of seven (7) Days, and two at age twenty-eight (28) Days. The fourth cylinder shall be held in reserve and tested only at the direction of the Architect or District's Representative. Cylinder testing procedures shall conform to ASTM C 39 for strength.

3.6.1.8 Slump tests shall be taken as required by Testing Laboratory to certify compliance with the Contract Documents. Slump shall be tested in accordance with ASTM C 143.

3.6.1.9 Minimum compressive strength of test cylinders, in pounds per square inch, shall not be less than the specified required design strength.

3.6.1.10 If minimum strengths of test cylinder fall below those specified, Architect or District's Representative may require test cores from hardened concrete to be taken and tested. Each core test, if taken shall consist of three cores. The cost of such cores and tests shall be borne by the Design Builder. Cores shall be taken in accordance with ASTM C 42, form locations selected by the Architect or District's Representative. The Design Builder shall repair core holes with a non-shrinking natural aggregate grout.

3.6.1.10.1 Concrete testing by coring shall be considered acceptable if the average strength of the three cores is equal to at least .85 of the minimum specified twenty-eight (28) day strength and if no single core strength is less than five hundred (500) psi below the twenty-eight (28) day strength.

3.6.2 Concrete Inspections

3.6.2.1 An authorized inspector from the testing agency shall be present at all times during placing of structural cast-in-place concrete. The inspector shall inspect and accept the accuracy of all reinforcing steel before concrete is placed. Concrete construction activities shall not proceed until inspections are complete and the inspected construction is approved.

3.6.3 Concrete Mix Designs

3.6.3.1 Refer to Volume 3 and 6, Division 3 (Concrete)

3.6.4 Concrete Plant Inspection

3.6.4.1 Structural concrete manufacturer(s) shall deliver a certificate in accordance with ASTM C 94, Section 15.1, and all items of Section 15.2 with the addition of type and brand of cement and admixtures, source and identification of aggregates to the Inspector with each mixer truck. Certificates shall be from a public weighmaster. The inspector shall not accept concrete that is not accompanied and identified by a certificate from a batch plant inspector.

3.6.4.2 Concrete shall be mixed at certified automatic concrete batch plants and shall have quality control as follows:

3.6.4.2.1 Laboratory designed mixes using adequate cement factors.

3.6.4.2.2 The testing agency shall perform continuous batch plant inspection.

3.6.4.2.3 Compliance with California Building Code (CBC) Standard 19-3.

3.6.4.2.4 Periodic inspection of quality of materials used may be made by testing laboratory, acceptable to Architect or District's Representative.

3.7 HIGH-STRENGTH GROUT

3.7.1 This Article applies to structural grout used below base plates and similar applications.

3.7.2 The placement of grout materials will be continuously inspected by the District's testing agency.

3.7.3 Grout compressive strength testing: The District will obtain a set of three samples from each batch. Samples will be tested at one (1) or three (3) days and seven (7) days following mixing. Compressive strengths shall exceed the manufacturer's published minimum strengths or eighty percent (80%) of their published typical compressive strengths.

3.8 EXPANSION ANCHOR BOLTS (TITLE 24, 1925 B.3.5)

3.8.1 Expansion type concrete anchor bolts shall be Hilti Kwik Bolt II or as indicated on the approved Construction Documents. Other brands of similar anchors will be acceptable with demonstration of equivalency. Submit manufacturer's specifications and ICBO reports. All anchors shall be installed with special inspection in accordance with the requirements of the Building Code.

3.8.2 Fifty percent of the anchors or alternate bolts in any group arrangement shall be proof tested in tension or torque, as specified on the drawings.

3.8.3 Testing Requirements:

3.8.3.1 Anchor diameter refers to the thread size.

3.8.3.2 Apply proof test loads to anchors without removing the nut, if possible. If not possible, remove nut and install a threaded coupler to the same tightness as the original nut using a torque wrench and apply load.

3.8.3.3 Reaction loads from test fixtures may be applied close to the anchor being tested, provided the anchor is not restrained form withdrawing by the fixture(s).

3.8.3.4 Test equipment is to be calibrated by an approved testing laboratory in accordance with standard recognized procedures.

3.8.3.5 The following criteria are applicable for the approval of installed anchors:

3.8.3.5.1 Hydraulic Ram Method: The anchor should have no observable movement at the applicable test load. For wedge and sleeve type anchors, a practical way to determine observable movement is that the washer under the nut becomes loose.

3.8.3.5.2 Torque Wrench Method: The applicable test torque must be reached within the following limits:

(a) One half (1/2) turn of the nut.

(b) One quarter (1/4) turn of the nut for the 3/8" sleeve anchor only.

3.8.3.5.3 Testing should occur a minimum of twenty-four (24) hours after installation of the subject anchors.

3.9 ADHESIVE ANCHORS

3.9.1 Installation Testing: Fifty percent of the anchors shall be pull-tested.

3.9.2 Proof Test Load: Pull test to twice the ICBO evaluation report design tension values or as indicated on the drawings.

3.9.3 Inspection: Installation of adhesive anchors will be continuously inspected in accordance with the requirements of the California Building Code, Section 1701, and the appropriate ICBO evaluation report.

3.10 EPOXY AND CEMENTITIOUS GROUTED DOWELS

3.10.1 Initial Testing: Install three anchors for each anchor size and installation position planned in allocation acceptable to the Architect or District's Representative. These anchors shall not be incorporated into the finished construction. The testing agency will pull-test these anchors at one hundred twenty-five percent (125%) of the values specified on the drawings.

3.10.2 Testing: The testing agency will pull-test fifty percent (50%) of the dowels in accordance with the schedule shown on the drawings. If any failures occur, the agency will pull-test one hundred percent (100%) of dowels in the vicinity or placed with the same batch of grout until at least twenty (20) tests demonstrate compliance. The Design Builder shall bear the cost of replacing failed dowels and re-inspection.

3.10.3 Inspection: Installation of epoxy grouted dowels will be continuously inspected in accordance with the California Building Code, Section 1701, and the appropriate ICBO evaluation report.

3.11 REINFORCING STEEL

3.11.1 Tests

3.11.1.1 Tests shall be performed before the delivery of steel to the Site. Steel that does not meet specifications shall not be shipped to the Project.

3.11.1.2 Testing procedure shall conform to ASTM A 615.

3.11.1.3 Sample at the place of distribution, before shipment. Make one tensile strength test and one bending test from samples out of 10 tons, or faction thereof, each size and kind of reinforcing steel, where taken from bundles as delivered from the mill and properly identified as to heat number. Mill analysis shall accompany report. Where identification number cannot be ascertained, or where random samples are taken, make one series of tests from each two and a half (2-1/2) tons, or fraction thereof, of each size and kind of reinforcing steel. Samples shall include not fewer than two pieces, each eighteen (18) inches long, of each size and kind of reinforcing steel.

3.11.1.4 Welds: Reinforcing bar welds shall be inspected. Tests of reinforcing bar welds shall be in accordance with ASTM E 709 and AWS D1.4. Chemical testing of reinforcing bars for welding shall conform to Title 24, 2603 B.5.2.

3.11.2 Inspector will inspect all reinforcement for concrete construction for size, dimensions, locations and proper placement. Special Inspector required for welding as required by Title 24, 1928 B.12. Inspector shall be present during welding of all reinforced steel.

3.11.3 Stone Veneer

3.11.3.1 All veneer shall be continuously inspected as required by the California Code or Regulations, Title 24, Part 2, Volume I, Section 1403 A.6.

3.12 STRUCTURAL STEEL INCLUDING MISCELLANEOUS STEEL

3.12.1 Mill certificates or affidavits and manufacturers' certifications shall be supplied to the inspector for verification of steel materials. Testing agency shall be notified at least three working days in advance of fabrication and supplied with the reports so that the inspector can make a shop inspection of the steel.

3.12.2 Inspection requests shall be based on Title 24, Part 2, California Building Code, Volume 2, Seismic Provisions for Structural Steel Buildings of the American Institute of Steel Construction, 2002.

3.12.3 Identify and mark steel in accordance with Section 2202B. Structural steel properly identifies need not be tested.

3.12.4 Tests of Steel Materials: If structural steel cannot be identified by heat or melt numbers, or if its source is questionable, not less than one tension test and one bend test will be made for each five tons or fractional part thereof. The cost of such testing will be borne by the Design Builder.

3.12.5 Testing and Inspection of Structural Steel:

3.12.5.1 Testing agency will visit the fabricator's plant to verify that materials used check with the mill tests, affidavits of test reports, and that fabrication and welding procedures meet specifications.

3.12.5.2 Testing agency shall visually check fabricated steel delivered to the Project against the working and reviewed shop drawings for compliance, and make physical tests and measurements as required to meet the Specifications.

3.12.5.3 Inspection of welding shall be in accordance with the requirements of section 2212 B.5.

3.12.5.4 Erection Inspection: Testing agency will visually inspect bolted and field welded connections, perform such additional tests and inspections of the field work as are required by the Architect or District's Representative and prepare test reports for the approval.

3.12.6 Ultrasonic Testing: All complete penetration multi-pass groove welds will be ultrasonically tested:

3.12.6.1 The District's testing agency will perform ultrasonic testing immediately after welding is complete. A second ultrasonic testing will be performed near the end of field welding for at least twenty-five percent (25%) of the field welded groove welds.

3.12.6.2 All defective welds shall be repaired and re-tested with ultrasonic equipment.

3.12.6.3 When ultrasonic indications arising from the weld root can be interpreted as either a weld defect or the backing strip itself, the backing strip shall be removed at the Design Builder's expense and, if no root defect is visible, the weld shall be retested. If no defect is indicated on this re-test, and no significant amount of the base and weld metal haven been removed, no further repair or welding is necessary. If a defect is indicated, it shall be repaired at the Design Builder's expense.

3.12.6.4 The ultrasonic instrumentation shall be calibrated by the technician to evaluate the quality of the welds in accordance with AWS D1.1.

3.12.6.5 Should defects appear in welds tested, repairs shall be similarly inspected at the Design Builder's expense and at the direction of the Architect or District's Representative until satisfactory performance is assured.

3.12.6.6 Other methods of inspection, for example, x-ray, gamma ray, magnetic particle, or dye penetrant, may be used on welds if deemed necessary by the Architect or District's Representative.

3.12.7 The testing laboratory will review welding procedure specifications and related documentation to verify compliance with AWS and the Contract Documents.

3.13 HIGH-STRENGTH BOLTS, NUTS AND WASHERS

3.13.1 Material Tests: High-strength bolts, nuts and washers will be sampled and tested in accordance with the requirements of the specification for High-Strength Bolts for Structural Steel Joints, including Suitable Nuts and Plain Hardened Washers, ASTM A325, or for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints, ASTM 490, latest editions, details of construction, and installation procedure.

3.13.2 Inspection of High-Strength bolt Installation: Inspection of high-strength bolt installations shall be made in accordance with Title 24, Section 2213B by an inspector specially approved for that purpose by District Representative. The inspector will check the materials, equipment, details of construction, and installation procedure. The inspector shall furnish the Architect or District's Representative with a report that the Work has been completed in every respect in compliance with the approved Drawings and Specifications.

END OF SECTION

PART 1 – GENERAL

RELATED DOCUMENTS

1.1. Drawings and general provisions of Section 00 50 00 (Form of Agreement), and other Division 1 Specification Sections, apply to this Section.

SUMMARY

1.2. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

1.3. Temporary utilities include, but are not limited to, the following:

A. Sewers and drainage.
B. Water service and distribution.
C. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
D. Heating and cooling facilities.
E. Ventilation.
F. Electric power service.
G. Lighting.
H. Telephone service.
I. High-speed Internet service.

1.4. Support facilities include, but are not limited to, the following:

A. Temporary roads and paving.
B. Dewatering facilities and drains.
C. Project identification and temporary signs.
D. Waste disposal facilities.
E. Field offices.
F. District field office.
G. Storage and fabrication sheds.
H. Lifts and hoists.
I. Temporary elevator usage.
J. Temporary stairs.
K. Construction aids and miscellaneous services and facilities.

1.5. Security and protection of the Work shall comply with the requirements of Article 14 of Section 00 50 00 (Form of Agreement) and include, but are not limited to, the following:

A. Environmental protection.
B. Stormwater control.
C. Tree and plant protection.
D. Pest control.
E. Site enclosure fence.
F. Security enclosure and lockup.
G. Barricades, warning signs, and lights.

H. Covered walkways.
I. Temporary enclosures.
J. Temporary partitions.
K. Fire protection.

1.6. Related Sections include the following:

A. Section 00 50 00 (Form of Agreement) for progress cleaning requirements.
B. Section 01 77 00 (Cleaning and Closeout Procedures) for closeout, cleaning procedures.
C. Divisions 2 through 33 for temporary heat, ventilation, and humidity requirements for products in those Sections.

DEFINITIONS

1.7. Permanent Enclosure: As determined by District, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

USE CHARGES

1.8. General: Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:

A. District's construction and management forces.
B. Architect and other design sub-consultants.
C. Testing agencies.
D. Inspection services.
E. Personnel of authorities having jurisdiction.

1.9. Sewer Service: Use District's existing sewer service without metering and without payment of use charges.

1.10. Water Service: Use water from District's existing water system without metering and without payment of use charges.

1.11. Electric Power Service: In existing structures use electric power from District's existing system without metering and without payment of use charges unless otherwise noted. For all new structures under construction and temporary facilities (including but not limited to all field offices and temporary construction facilities) Design Builder shall engage the appropriate local utility company to install temporary service. Pay electrical service use charges for all new structures under construction and temporary facilities.

1.12. Telephone and High-speed Internet Service: Design Builder shall install and pay for all telephone (voice and facsimile) and High-speed Internet service use and maintenance charges and insure that such utilities are available for use by all entities engaged in construction activities at Project site.

1.13. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Design Builder to obtain required certifications and permits.

Material Safety Data Sheets (MSDS)

1.14. Design Builder is required to ensure Material Safety Data Sheets are available in a readily accessible place at the Work Site for any material requiring a Material Safety Data Sheet per the Federal “Hazard Communication” standard, or employees right to know law. The Design Builder 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.

PROJECT CONDITIONS

1.15. Temporary Utilities: At the earliest feasible time, when acceptable to District, change over from use of temporary service to use of permanent service.

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before District's acceptance, regardless of previously assigned responsibilities.

1.16. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

A. Keep temporary services and facilities clean and neat.

B. Relocate temporary services and facilities as required by progress of the Work.

C. If power greater than that available at nearby convenience outlets is required, make arrangements for such service and pay all costs of wiring and current. Repair existing facilities to originally found conditions.

PART 2 - PRODUCTS

1. MATERIALS

1.1. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by District. Provide materials suitable for use intended.

1.2. Pavement: Comply with Division 2 [Section "Asphaltic Concrete Paving."] [Section "Portland Cement Concrete Paving."] [Pavement Sections.]

1.3. Portable and Temporary Chain-Link Fencing: Minimum 2-inch (50-mm) 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch-(73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails.

1.3.1. For portable chain-link fencing, provide galvanized steel support bases for supporting posts. Use bolt clamp connections. No wire ties to secure between fence panels.

1.3.2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.

1.3.3. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide District with three sets of keys.

1.3.4. Visual Barrier: Provide and install mesh screen with District approved connections to fencing for visual barrier

1.4. Lumber and Plywood: Comply with requirements in Division 6 Section Rough Carpentry."

1.5. Paint: Comply with requirements in Division 9 Section "Painting."

1.6. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.

1.7. Water: Potable.

2. EQUIPMENT

2.1. General: Provide equipment suitable for use intended.

2.2. Field Office and District Field Office: Mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading. Windows and doors are to have security bars and operable shades.

2.3. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

2.3.1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

2.4. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

2.5. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.

2.6. Heating Equipment: Unless District authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

2.6.1. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.

2.7. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

2.8. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

INSTALLATION, GENERAL

1.1. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by the District. See Article 3.3..1

1.2. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities and approved by District.

2. TEMPORARY UTILITY INSTALLATION

2.1. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.

2.1.1. Arrange with utility company, District, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

2.1.2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.

2.1.3. Obtain easements to bring temporary utilities to Project site where District's easements cannot be used for that purpose.

2.2. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If

neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.

2.2.1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.

2.2.2. Connect temporary sewers to municipal system as directed by sewer department officials.

2.2.3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.

2.3. Water Service: Use of District's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to District.

2.3.1. The Design Builder shall be responsible for undue wasting of water used on the Work.

2.3.2. Design Builder to furnish hoses and temporary piping placed where water connections are available.

2.3.3. Provide adequate fire protection for the duration of work in accordance with local codes, ordinances and the State Fire Marshal.

2.3.3.1. The Design Builder shall take necessary precautions to guard against and eliminate possible fire hazards and to prevent damage to construction work, building materials, equipment, and public property. The Design Builder shall be responsible for providing, maintaining and enforcing fire protection methods

2.3.4. here installation below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.

2.4. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

2.4.1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.

2.4.2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.

2.4.3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.

2.4.4. Drinking-Water Facilities: Provide bottled-water, drinking-water units and paper cup supply.

2.5. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.

2.6. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

2.6.1. Unless the District Project Manager authorizes an alternate procedure in writing, in advance of the start of construction; continuously ventilate all construction work areas and spaces with 100% outdoor (fresh) air for at least 30 days prior to substantial completion of work. In areas, which make use of natural ventilation such as windows, install temporary fans sufficient to provide no less than three air changes per hour. In all cases make sure that air is exhausted from construction work areas directly to the outdoors; do not re-circulate air or ventilate to other enclosed areas either within the occupied school or the construction area itself. Continuously operate ventilation systems and/or temporary fans 24 hours per day, 7 days per week, providing all measures necessary to allow the operation of ventilation systems and fans while maintaining the security of the site.

2.6.1.1. When volatile organic compound, and/or odor generating activities are performed during the 30-day ventilation period provide temporary exhaust ventilation to capture emissions and exhaust them directly to the outdoors. Extend the building flush out for a minimum of four days after the completion of any such activities.

2.6.1.2. During ventilation, make necessary provisions to temper supply air or heat spaces sufficiently to prevent condensation, water damage, and/or mold growth. Do not attempt to speed the off gassing of materials and/or curing of finishes by increasing room temperatures above normal levels (“baking” the building and/or components)

a.

2.6.1.3. Additional Conditioning at Move-In: Continue to operate ventilation systems at 100% fresh air during occupant move-in and unpacking. Do not perform final balancing of the ventilation system until two weeks after the move-in.

2.7. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.

2.7.1. Install power distribution wiring overhead and rise vertically where least exposed to damage.

2.8. Electric Power Service: Where approved by the District, use of District's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to District.

2.9. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.

2.9.1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

2.10. Lighting: Provide temporary lighting, as required, with local switching that provides adequate illumination for construction operations and traffic conditions.

2.11. Equipment: Provide equipment throughout construction period for common-use facilities used by all personnel engaged in construction activities.

2.11.1. Provide the following at District Field office:

2.11.1.1. CM Office
2.11.1.1.1. One fax, copy, scan machine with one dedicated phone line.
2.11.1.2. IOR Office
2.11.1.2.1. One fax copy, scan machine with one dedicated phone line. Conference Room
2.11.1.2.2. One telephone with conference and speaker capability: Provide dedicated phone line.
2.11.1.2.3. Provide and install separate High-speed Internet service, modem, and two (2) four-port wireless router for networking hardware/software for use during construction as directed by District's representative.
2.11.1.2.4. Design Builder is responsible to maintain continuous High-speed Internet and telephone service throughout construction.
2.11.1.2.5. Provide an answering machine or voice mail service on all telephones in the District's field office.
2.11.1.2.6. Provide three (3) sets of keys for each door at the trailers.
2.11.1.2.7. District Office and Conference Rooms to have weekly (or more) Janitorial Services.
2.11.1.2.8. District Field Offices shall have one (1) Men's and one (1) Women's interior toilet facilities with hot/cold water. Bottled drinking water with cups shall be provide for the duration of the Project.

2.11.1.3. Provide the following at Design Builder Field office:
2.11.1.3.1. Provide minimum of one (1) Scan/Copy/Print machine.
2.11.1.3.2. Provide separate High-speed Internet service, modem, and four-port wireless router for networking hardware/software for use during construction.

2.11.1.3.3. Design Builder is responsible to maintain continuous High-speed Internet and telephone service throughout construction.

2.11.1.4. In the Field Office, post a list of important telephone numbers.

2.11.1.4.1. Police and fire departments.
2.11.1.4.2. Ambulance service.
2.11.1.4.3. Design Builder's home office.
2.11.1.4.4. Architect's office.
2.11.1.4.5. Engineers' offices.
2.11.1.4.6. District's office.
2.11.1.4.7. Principal sub-Design Builders' field and home offices.

2.11.1.5. Furnish superintendent with an electronic paging device or a portable two-way radio for use when away from field office.

2.11.1.6. Provide a portable cellular telephone for superintendent's use in making and receiving telephone calls when away from field office.

3. SUPPORT FACILITIES INSTALLATION

3.1. General: Comply with the following:

3.1.1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities in locations approved by the District.

3.1.2. Provide incombustible construction for offices, shops, and sheds located within construction area. Comply with NFPA 241.

3.1.3. Maintain support facilities until after project final completion and with approval of the District.

3.2. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas, if required, as indicated on Drawings.

3.2.1. Provide a reasonably level, graded, well-drained subgrade of satisfactory soil material, compacted to not less than 95 percent of maximum dry density in the top 6 inches (150 mm).

3.2.2. Provide gravel paving course of subbase material not less than 6 inches (75 mm) thick; roller compacted to a level, smooth, dense surface.

3.2.3. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

3.2.4. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

3.2.5. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.

3.2.6. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 2 Section "Earthwork."

3.2.7. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

3.2.8. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 2 Section "Hot-Mix Asphalt Paving."

3.3. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.

3.4. Dewatering Facilities and Drains: Comply with requirements in applicable Division 2 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.

3.4.1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.

3.4.2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.

3.5. Project Identification and Temporary Signs: Prepare a minimum of two (2) Project identification signs not less than 32 square feet in area. Install signs in locations approved by the District to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

3.5.1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated. District to provide project information to be included on signage.

3.5.2. Prepare temporary signs to provide directional information to construction personnel and visitors.

3.5.3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood. Support on posts or framing of preservative-treated wood or steel. Do not install signage on any fencing – temporary or permanent.

3.5.4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.

3.6. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

3.6.1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.

3.6.2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.

3.7. Professional Cleaning Services: Provide professional cleaning services on a weekly basis for temporary offices, first-aid stations, toilets, and similar areas.

3.8. District Field Office: Provide an insulated, weathertight, air-conditioned field office for use as by the District, District's Representative, Inspector of Record, and Architect; of sufficient size to accommodate required office personnel. District field office to contain office for IOR, office for Construction Manager (CM), Project Manager (PM), Project Engineer (PE), Project Administrator (PA) and common meeting area as detailed below. Provide and maintain all new equipment below, including all ancillary supplies required to operate equipment provided under contract. (Such as; copier toner, copy paper, drinking cups, etc).

3.8.1. IOR Office Requirements as follows:
3.8.1.1. Provide a minimum 140 sq. ft. (13 sq. m) office with lockable door.
3.8.1.2. One desk and one ergonomic chair, two four-drawer file cabinets, a plan table, a plan rack, and one bookcase.
3.8.1.3. One plain paper fax, copier, scanner, copier model HP Laser Jet M1522n MFP or approved equal with capability to fax multiple pages at a time and print a confirmation page.

3.8.2. CM/PM Office Requirements as follows:
3.8.2.1. Provide a minimum 140 sq. ft. (13 sq. m) office with lockable door.
3.8.2.2. One desk and one ergonomic chair, two four-drawer file cabinets, a plan table, a plan rack, and one bookcase.
3.8.2.2.1.1. Provide one (1) new digital camera with minimum 1 gigabyte storage card.
3.8.2.2.1.1.1. One plain paper fax, copier, scanner, copier model HP Laser Jet M1522n MFP or approved equal with capability to fax multiple pages at a time and print a confirmation page.

3.8.3. PE/PA Office Requirements as follows:
3.8.3.1. Provide a minimum 64 sq. ft. (7.8 sq. m) workstation with overhead storage and task lighting.
3.8.3.2. One desk or worksurface and one ergonomic chair, two four-drawer file cabinets and pencil drawer (lockable), a plan table or worksurface, a plan rack, and one bookcase.

3.8.4. Common Meeting Area:

3.8.4.1. Provide a room of not less than 240 sq. ft. (22.5 sq. m) for Project meetings. Furnish room with conference table suitable for 14 people, 14 folding chairs, 4-foot-by-6-foot- tack board, and 4-foot-by-6-foot- white board.

3.8.4.2. One desk and one ergonomic chair, one four-drawer file cabinet.

3.8.4.3. Water cooler with hot and cold spigot.

3.8.4.4. DB team shall provide a scanner/printer/copier capable of printing B/W and in Color on 8-1/2" x 11" and 11" x 17" paper.

3.9. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.

4. SECURITY AND PROTECTION FACILITIES INSTALLATION

4.1. General: Comply with the requirements of Article 14 of 00 50 00 (Agreement).

4.2. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from surrounding properties. Design Builder shall perform all work in compliance with all applicable rules, regulations, laws, and local ordinances including, without limitation, all noise and light limitations.

4.3. Storm Water Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

4.4. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees (if identified for protection) to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

4.5. Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain two-year extended warranty for District. Perform control operations lawfully, using environmentally safe materials approved by the District.

4.6. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. The Design Builder is required to secure all areas of work and set security alarms when leaving the site.

4.7. Barricades, Warning Signs, and Lights: Comply as required with local authorities and State safety ordinances, standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazards. Where appropriate and needed, provide lighting, including flashing red or amber lights.

4.8. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

4.8.1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

4.8.2. Vertical Openings: Close openings of 25 sq. ft. (2.3 sq. m) or less with plywood or similar materials.

4.8.3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.

4.8.4. Install tarpaulins security using fire retardant treated wood framing and other materials.

4.9. Temporary Partitions: Erect and maintain effective dustproof partitions and temporary enclosures to prevent dust and dirt migration into areas of completed construction and to separate areas from fumes, odors and noise. Construction of temporary barriers shall take into consideration existing hazardous materials present in building finishes.

4.9.1. Construct dustproof partitions of not less than nominal 4-inch (100-mm) studs, 5/8-inch (16-mm) gypsum wallboard with joints taped on occupied side, and 1/2-inch (13-mm) fire-retardant plywood on construction side.

4.9.2. Insulate partitions to provide noise protection to occupied areas.

4.9.3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.

4.9.4. Protect air-handling equipment.

4.9.5. Weatherstrip openings.

4.9.6. Where the heating, ventilating, and/or air conditioning (HVAC) system and ducting is shared between the construction and completed areas of the Project, either isolate the areas by duct capping or conduct construction operations with ventilation shut down and sealed after hours or weekends.

4.10. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to

protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

4.10.1. Store combustible materials in containers in fire-safe locations.

4.10.2. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.

4.10.3. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

4.10.4. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

4.10.5. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

4.10.6. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

5. OPERATION, TERMINATION, AND REMOVAL

5.1. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

5.2. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.

5.2.1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

5.2.2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

5.3. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities without District approval

5.4. Termination and Removal: Remove each temporary facility when authorized by the District. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

5.4.1. Materials and facilities that constitute temporary facilities are the property of Design Builder. District reserves right to take possession of Project identification signs.

5.4.2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

5.4.3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 “Closeout Procedures”. If LBP was disturbed during renovation the final cleaning shall meet the minimum requirements of 40 CFR Part 745 in addition to Division 1 “Closeout Procedures”.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

1.1.1 This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and product substitutions.

1.1.2 Related Sections include the following:

1.1.2.1 Section 01 42 00 (References) for applicable industry standards for products specified.

1.1.2.2 Section 01 77 00 (Cleaning and Closeout Procedures) for submitting warranties for Contract closeout.

1.2 DEFINITIONS

1.2.1 Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1.2.1.1 Refer to District Standards and Criteria Documents for Sole Source Material or Equipment.

1.2.1.2 Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.

1.2.1.1 New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

1.2.2 Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Design Builder, as allowed in Section 00 10 00 (Request for Proposals).

1.2.2.1 The following are not considered substitutions:

1.2.2.1.1 Revisions to Contract Documents requested by the District's Representative.

1.2.2.1.2 Specified options of products and construction methods included in Contract Documents.

1.2.2.1.3 The Design Builder's determination of and compliance with governing regulations and orders issued by governing authorities.

1.2.2.2 Design Builder will be held responsible for: (a) all costs and claims arising from any cost or schedule impact resulting from the District's approval of a requested substitution and (b) all costs and claims arising from any cost or schedule impact resulting from any substitution not approved by the District.

1.3 SUBMITTALS

1.3.1 See Section 01 33 00 (Submittal Procedures).

1.3.2 Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1.3.2.1 Coordinate product list with Design Builder's Contract Schedule and the Submittals Schedule.

1.3.2.2 Form: Tabulate information for each product under the following column headings:

1.3.2.2.1 Specification Section number and title.

1.3.2.2.2 Generic name used in the Contract Documents.

1.3.2.2.3 Proprietary name, model number, and similar designations.

1.3.2.2.4 Manufacturer's name and address.

1.3.2.2.5 Supplier's name and address.

1.3.2.2.6 Installer's name and address.

1.3.2.2.7 Projected delivery date or time span of delivery period.

1.3.2.2.8 Identification number on Contract Schedule network.

1.3.2.2.9 Identification of items that require early submittal approval for scheduled delivery date.

1.3.2.3 Product List: Within sixty (60) Days after date of commencement of the Work, submit five (5) physical copies of product list and submit one (1) electronic copy. Include a written explanation for omissions of data and for variations from Contract requirements.

1.3.2.4 District's Action: District will respond in writing to Design Builder within fifteen (15) Days of receipt of each product list. District's

response will include a list of unacceptable product selections and a brief explanation of reasons for this action. District's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

1.3.3 QUALITY ASSURANCE

1.3.4 Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

1.3.5 Compatibility of Options: If Design Builder is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.3.6 Underwriter's Laboratories, Inc. ("UL") Label: Where laboratory standards have been established and label service is available, materials and equipment shall bear the appropriate UL, Warnock-Hersey, or Factory Mutual label.

1.3.7 Manufacturers' Trademarks and Names: District's Representative reserves the right to review and request the removal or redesign of manufacturers' trade marks and names on items of material and equipment that will be exposed to view in the completed Work. Such removal or redesign shall be completed with no adjustment to the Stipulated Sum.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

1.4.1 Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1.4.2 Delivery and Handling:

1.4.2.1 Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

1.4.2.2 Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

1.4.2.3 Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

1.4.2.4 Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

1.4.2.5 Reject delivery of damaged or defective items. Promptly remove damaged or defective products from the Project site and replace with new at no change to the Stipulated Sum.

1.4.3 Storage:

1.4.3.1 Store products to allow for inspection and measurement of quantity or counting of units.

1.4.3.2 Store materials in a manner that will not endanger Project structure.

1.4.3.3 Store products that are subject to damage by the elements under cover in a weather tight enclosure above ground, with ventilation adequate to prevent condensation.

1.4.3.4 Store cementitious products and materials on elevated platforms.

1.4.3.5 Store sand, rock, or aggregate materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

1.4.3.6 Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

1.4.3.7 Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

1.4.3.8 Protect stored products from damage.

1.4.3.9 Periodically inspect stored products to assure that products are maintained under specified conditions and are free from damage and deterioration.

1.4.3.10 The use of mechanical or electrical rooms for storage of materials is prohibited.

1.4.4 Imported Materials and Products:

1.4.4.1 Imported materials and products require special handling in shipping crates. Document and examine materials at the following points:

1.4.4.1.1 At the origination point prior to crating.

1.4.4.1.2 At the port of embarkation (for damage to crates).

1.4.4.1.3 At the port of entry (for damage to crates).

1.4.4.1.4 Immediately following delivery to the Site.

1.4.4.2 If crates show signs of damage, open them and inspect materials and products.

1.4.4.3 Reject damaged or defective products or materials, and replace promptly.

1.4.4.4 Provide detailed Bill of Goods at each point listed above, indicating quantity and condition of each item. At port locations, Bill of Goods may be accepted unless damage is observed.

1.5 PRODUCT WARRANTIES

1.5.1 Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Design Builder of obligations under requirements of the Contract Documents.

1.5.1.1 Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to District.

1.5.1.2 Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for District.

1.5.2 Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1.5.2.1 Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

1.5.2.2 Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.

1.5.3 Submittal Time: Comply with requirements in Section 01 77 00 (Closeout Procedures).

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

2.1.1 General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

2.1.1.1 Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2.1.1.2 Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

2.1.1.3 District reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

2.1.1.4 Where products are accompanied by the term “as selected,” District will make selection.

2.1.1.5 Where products are accompanied by the term “match sample,” sample to be matched is District’s.

2.1.1.6 Descriptive, performance, and reference standard requirements in the Specifications establish “salient characteristics” of products.

2.1.1.7 Or Equal: Where products are specified by manufacturer’s name and accompanied by the term “or equal,” comply with provisions in Article 2.2, Product Substitutions, to obtain approval for use of an unnamed product.

2.1.2 Product Selection Procedures:

2.1.2.1 Product: Where Specifications name a single product and manufacturer, and indicate “no known equal,” provide the named product that complies with requirements.

2.1.2.2 Manufacturer/Source: Where Specifications name a single manufacturer or source, and indicates “no known equal,” provide a product by the named manufacturer or source that complies with requirements.

2.1.2.3 Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.

2.1.2.4 Manufacturers: Where Specifications include a list of manufacturers’ names, provide a product by one of the manufacturers listed that complies with requirements.

2.1.2.5 Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches District’s sample. District’s decision on whether a proposed product matches will be final.

2.1.2.5.1 When approval of a color, pattern or texture sample match by the District is required, provide the best match that complies with the specification and also provide the two nearest in the selection range to either direction from the same manufacturer/supplier. Application examples are:

2.1.2.5.1.1 *Color* – shall have two color hues or shades darker and two color hues or shades lighter. Total of five selections available.

2.1.2.5.1.2 *Pattern* – shall have two patterns that are less dense (or smaller) and two patterns that are more dense (or larger). Total of five selections available.

2.1.2.5.1.3 *Texture* – shall have two textures that are less rough (or smaller) and two patterns that are more rough (or larger). Total of five selections available.

2.1.2.5.2 If no product available within specified category matches and complies with other specified requirements, comply with provisions in Article 2.2 (Product Substitutions) below for proposal of product.

2.1.2.6 Visual Selection Specification: Where Specifications include the phrase “as selected from manufacturer’s colors, patterns, textures” or a similar phrase, select a product that complies with other specified requirements.

2.1.2.6.1 Standard Range: Where Specifications include the phrase “standard range of colors, patterns, textures” or similar phrase, District will select color, pattern, density, or texture from manufacturer’s product line that does not include premium items.

2.1.2.6.2 Full Range: Where Specifications include the phrase “full range of colors, patterns, textures” or similar phrase, District will select color, pattern, density, or texture from manufacturer’s product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 – GENERAL

1. SUMMARY

1.1. Section Includes: Administrative and procedural requirements for contract closeout, including but not limited to, the following:

1.1.1. Substantial Completion requirements.

1.1.2. Inspection (Punch List) procedures.

1.1.3. Final Completion requirements

1.1.4. Project Record Documents.

1.1.5. Operations and Maintenance Manuals

1.1.6. Spare parts/materials.

1.1.7. Warranties (Minimum 2 years unless manufacturer's warranty is greater.)

1.1.8. Two-year maintenance and service agreements.

1.1.9. Demonstration and Training of District's personnel.

1.1.10. Final Cleaning.

1.2. Related Sections:

1.2.1. Section 00 50 00 (Form of Agreement) for requirements for Project Completion and Final Payment.
1.2.2. The Conditions for the Contract and the other sections of Division 1 apply to this section as fully as if repeated herein.
1.2.3. Divisions 2 through 33 Sections for specific closeout and special cleaning requirements for products of those sections.

2. SUBSTANTIAL COMPLETION

2.1. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion by phase, complete the following. List items below that are incomplete in request.

2.1.1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list and reasons why the Work is not complete.

2.1.2. For the final phase of the Project, advise the District of pending insurance changeover requirements.

2.1.3. For the final phase of the Project, submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

2.1.4. Obtain and submit releases permitting District unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

2.1.5. For the final phase of the Project, prepare, sign, and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs (and photographic negatives or a disk with all digital files), damage or settlement surveys, property surveys, and similar final record information. Deliver operation and maintenance manuals and Project Record Documents at least two weeks (14 days) before training and request for Substantial Completion Inspection.

2.1.6. For the final phase of the Project, deliver all tools, spare parts, extra materials, and similar items that are a permanent part of the installed equipment, to the District. Label with manufacturer's name and model number where applicable.

2.1.7. All plumbing and mechanical equipment shall operate quietly and free from vibration. Properly adjust, repair, balance, or replace equipment producing objectionable noise or vibration. Provide additional brackets, bracing, or other methods to prevent objectionable noise or vibration. All systems shall operate without humming, surging, or rapid cycling.

2.1.8. Complete startup testing of systems.

2.1.9. Complete training of the District's staff per Part 3 of this section. Submit training logs and attendance sheets.

2.1.10. Submit test/adjust/balance records.

2.1.11. Properly mount and post all operating instructions.

2.1.12. Make final changeover of permanent locks and deliver properly marked keys to District. Advise District's personnel of changeover in security provisions.

2.1.13. For the final phase of the Project and as approved by the District, terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

2.1.14. Advise District of changeover in heat and other utilities.

2.1.15. Submit changeover information related to District's occupancy, use, operation, and maintenance.

2.1.16. Complete final cleaning requirements per Paragraph 3.2, Final Cleaning.

2.1.17. Touch up and otherwise repair and restore marred and exposed finishes to eliminate visual defects.

2.1.18. Deliver evidence of compliance with any and all requirements of all applicable governmental regulatory agencies at all levels, including District, City, State (DSA and Emergency Planning Department) and Federal government and agencies.

2.1.19. Submit certificates of inspection for vertical transportation systems, and life safety systems.

2.1.20. Submit copies of the fire alarm certification.

2.1.21. Certificates: For the final phase of the Project, submit manufacturer's representative's certification that work has been installed in accordance with manufacturer's recommendations.

2.1.22. Complete all Testing requirements per Section 01 88 20 (Miscellaneous Hazardous Materials Requirements).

2.2. Inspection: After all requirements of the Substantial Completion preliminary procedures have been completed, submit a written request for inspection for Substantial Completion. Give notice at least 7 working days in advance from the time the final inspection is to be performed. District will either proceed with inspection or notify Design Builder of unfulfilled requirements. Refer to Paragraph 1.4, List of Incomplete Items (Punch List).

2.2.1. Initial Inspection (Punch List): The Design Builder or his principal superintendent, authorized to act on behalf of the Design Builder, is to assemble a list of unfinished work items and assign costs to each item.

2.2.2. Final Inspection (Punch List): The Design Builder or his principal superintendent, authorized to act on behalf of the Design Builder, shall accompany the District on the final inspection tour. Principal Subcontractors and Consultants that the District may request to be present will also attend. The District will verify the Design Builder's Initial Inspection and recommend any changes.

2.2.3. If the Work has been substantially completed in accordance with the Contract Documents, and only minor corrective measures are required, the District will conditionally accept the Work and will file for the Notice of Completion based upon the Design Builder's assurance that the corrective measures will be completed within the shortest practicable time period.

2.2.4. If the Work has not been substantially completed in accordance with the Contract Documents, and several corrective measures are still required, the District will not accept the Work or record the Notice of Completion. The Design Builder shall complete or correct the items listed on the Initial Inspection and the Final Inspection punch list and then call for a re-inspection, following the procedure outlined above.

2.2.5. Re-inspection: Request for re-inspection when the Work identified in previous inspections as incomplete is completed or corrected. More than one (1) request of the District to make a re-inspection shall be considered an additional service of

District, District's Representative, and/or Inspector of Record, and all subsequent costs will be deducted from the Design Builders final payment.

3. FINAL COMPLETION

3.1. Preliminary Procedures: Before determining the date of Final Completion, complete the following:

3.1.1. Submit a final Application for Payment according to Section 00 50 00 (Agreement).

3.1.2. Submit affidavit of payment of debts and claims.

3.1.3. Submit affidavit of release of liens.

3.1.4. Submit consent of Design Builder's surety to final payment,

3.1.5. Submit complete payroll certifications.

3.1.6. Submit certified copy of District's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by the District's representative. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3.1.7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

3.1.8. Submit pest-control final inspection report and warranty.

3.1.9. Submit all guarantees and warranties. Refer to Paragraph 1.7, Warranties.

3.1.10. Submit all Material Safety Data sheets.

3.1.11. Submit copies of all Verified Reports.

3.1.12. Submit a list of all Subcontractors of every tier providing services and/or materials in connection with the Project, in a formal, adequately bound, cataloged form, which shall include the names, addresses, telephone numbers and fax numbers of such persons, and shall further include notices as to where pertinent persons can and may be reached for emergency service, inclusive of nights, weekends and holidays.

4. DESIGN BUILDER'S LIST OF INCOMPLETE ITEMS (PUNCH LIST)

4.1. Preparation: Submit ten copies of each list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by the Design Builder that are outside the limits of construction.

4.1.1. The list is to be in Microsoft Excel, electronic format. The format is available from the District for the Design Builder's use.

4.1.2. Organize the list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor in each building in the project. Each line item is to have a unique number associated with the room number (do not re-number items once they have been assigned a number).

4.1.3. Organize items by space. Each outstanding item is to be based on the room number where the problem exists and individually numbered.

4.1.4. Include the flowing information at the top of each page:

4.1.4.1.1. Project name.

4.1.4.1.2. Date.

4.1.4.1.3. Name of District's Representative.

4.1.4.1.4. Name of Inspector or Record.

4.1.4.1.5. Name of Design Builder.

4.1.4.1.6. Page Number.

5. PROJECT RECORD DOCUMENTS

5.1. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for the District's representative and Inspector of Record's reference during normal working hours. Submit Record Documents as described in this Section 00 50 00 (Agreement) and 01 11 20 (Design Services and Deliverables).

5.2. Record Drawings: Maintain and submit one signed set of prints of Contract Drawings and Shop Drawings.

5.2.1. Mark Record drawings to show the actual installation where installation varies from that shown originally as well as construction added to the Contract that is not indicated on the Contract Drawings. Require individual or entity who obtained record data, where individual or entity is installer, Subcontractor, or similar entity, to prepare the marked-up Record Prints.

5.2.1.1. Keep Record Drawings current and legible, and available, on site, for inspection at all times by the Inspector of Record, and District's representative.

5.2.1.2. Give particular attention to information on concealed elements that cannot be readily identified and recorded later. Concealed shall mean construction installed underground or in an area which cannot be readily inspected by use of access panels, inspection plates or other removable features.

5.2.1.3. Accurately record information in an understandable drawing technique.

5.2.1.4. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

5.2.1.5. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

5.2.2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

5.2.3. Mark important additional information that was either shown schematically or omitted from original drawings.

5.2.4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, RFI numbers, and similar identification where applicable.

5.2.5. Identify, sign and date each Record Drawing: include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable cover sheets. Include identification on cover sheets.

5.3. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation.

5.3.1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

5.3.2. Mark copy with proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

5.3.3. Note related Change orders, Record Drawings, where applicable.

5.4. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

5.4.1. Include Material Safety Data Sheets.

5.4.2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

5.4.3. Include significant changes in the product delivered to Project site and changes in manufacturer's written instruction for installation.

5.4.4. Note related Change Orders, Record Drawings, where applicable.

6. OPERATIONS AND MAINTENANCE MANUALS

6.1. Assemble 3 copies of complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Section and as follows:

6.1.1. Manufacturer's Manuals: Submit complete installation, operation, maintenance and service manuals, and printed instructions and parts lists for all materials and equipment where such printed matter is regularly available from the manufacturer. This includes, but is not limited to such service manuals as may be sold by the manufacturer covering the operation and maintenance of his items, and complete replacement parts lists sufficiently detailed for parts replacement ordering to manufacturer. Piping diagrams and wiring diagrams are to be included. Bound publications need not be assembled in binders.

6.1.1.1. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title “OPERATION AND MAINTENANCE MANUAL,” Project name, and subject matter of contents.

6.1.2. Equipment Nameplate Data: Submit a typewritten list of all mechanical and electrical equipment showing exact equipment nameplate data. Identify equipment by means of names, symbols, and numbers used in the contract documents

6.1.3. System Operating Instructions: Submit typewritten instructions covering operation of the entire system as installed (not duplicating manufacturer's instructions for operating individual components). Include schematic flow and control diagrams as appropriate and show or list system valves, control elements, and equipment components using identification symbols and numbers, including operating standards. List rooms, area of equipment served, and show proper settings for valves, controls, and switches. Incorporate emergency instructions and procedures, startup and shutdown procedures, seasonal procedures and weekend operations.

6.1.4. System Maintenance Instructions: Submit typewritten instructions covering routine maintenance of system. List each item of equipment requiring inspection, lubrication, or service and briefly describe such maintenance, including types of lubricants and frequency of service. It is not intended that these instructions duplicate manufacturer's detailed instructions. Give name, address and phone number of nearest firm authorized or qualified to service equipment or provide parts

6.1.5. Wall Mounted Data: Frame one set of typewritten system instructions and diagrams as required under Paragraphs .3 and .4 above, covered with glass and mounted in locations as directed by the District. This set of instructions is in addition to the required herein.

7. WARRANTIES & GUARANTEES

7.1. All submitted Warranty and Guaranty forms will be on the Peralta Community College District's Warranty and Guaranty format. Original to be provided.

7.2. Warranties and guarantees for fire/life safety work such as fire alarm, sprinkler, emergency and exit lighting, and exiting pathway systems such as: Elevator, wheelchair lifts, etc. shall have specific language "in the event of our failure to respond and act within 3 hours after being notified in writing by the District, we authorize the District to proceed to have the defects repaired or replaced and made whole, together with any other adjacent work which may be displaced or damaged by so doing, at our expense, and we will honor and pay the costs and charges therefore upon demand. This work shall not invalidate any and all warranties and guarantees."

7.3. Submittal Time: Submit duplicate written warranties and guarantees on request of District for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

7.4. Partial Occupancy: Submit properly executed warranties and guarantees within 15 days of completion of designated portions of the Work that are completed and occupied or used by District during construction period by separate agreement with Design Builder.

7.5. Organize warranty and guarantee documents into an orderly sequence based on the table of contents of the Project Manual.

7.5.1. Bind warranties and guarantees in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to receive 8-1/2-by-11-inch (115-by-280-mm) paper.

7.5.2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty and guarantee. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

7.6. Provide additional copies of each warranty and guarantee to include in operation and maintenance manuals.

PART 2 – PRODUCTS

1. MATERIALS

1.1. Cleaning Agents: Only use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished

surfaces. All cleaners shall be specifically designed for the purpose intended, safe for use on the intended object to be cleaned, and safe to pupils, staff and the public. Refer to the District's standards for cleaning products approved by the District.

1.2. Commercial floor wax stripper, Easterday Ammo-Strip or approved equal, capable of removing metal interlock water emulsion floor finish.

1.3. Floor finish shall be minimum 20% solids content high-gloss wax. Acceptable products:

1.3.1. Spartan Sunny-Side

1.3.2. Spotlight (Brulin Company-800-776-7149)

1.3.3. Champion Once-A-Year

1.4. Graffiti Remover (non-toxic): SO-SAFE BY DX, Inc., or approved equal.

1.5. Germicidal Cleaner must be E.P.A. registered germicidal cleaner and deodorizer appropriate for use in public school buildings. DB team should use PCCD approved COVID-19 Sanitizer.

PART 3 – EXECUTION

1. DEMONSTRATION AND TRAINING

1.1.1. Instruction: After Work under this contract is completed, tested, and before acceptance, and not less than 14 days after submittal of the operation and maintenance data required in Paragraph 1.6, Operations and Maintenance Manuals, operate all systems for a period of three 8-hour days during which time keep on the project competent personnel familiar with the items installed whose full-time assignment will be to instruct the District's maintenance personnel in the operation and maintenance of the equipment and systems.

1.1.2. Provide instructors experienced in operation and maintenance procedures.

1.1.3. Provide instruction at mutually agreed-upon times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.

1.1.4. Schedule training with District, through District's representative, with at least seven days notice.

1.1.5. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

1.1.6. Do not conduct this instruction period before completion of piping and equipment labeling.

1.2. Provide an instruction period sufficient to cover the training required. This instruction period shall be in addition and subsequent to any period of operation, test and adjustment called for elsewhere in this specification.

1.3. Program Structure: develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction of the following:

1.3.1. System design and operational philosophy.

1.3.2. Review of documentation.

1.3.3. Operations.

1.3.4. Adjustments.

1.3.5. Troubleshooting.

1.3.6. Maintenance.

1.3.7. Repair.

2. FINAL AND END-OF-PHASE CLEANING

2.1. General: Provide final cleaning at the completion of each phase of the work and final project completion. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal, State and local environmental and antipollution regulations. If LBP was disturbed during renovation the final cleaning shall meet the minimum requirements of 40 CFR Part 745.

2.2. Cleaning: Employ professional cleaning service for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

2.2.1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for any phase of Project:

2.2.1.1. Clean Project site, yard, and grounds in areas disturbed by construction activities including landscape development areas, of rubbish, waste material, letter, and other foreign substances.

2.2.1.2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

2.2.1.3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

2.2.1.4. Remove tools, construction equipment, machinery, and surplus material from Project site.

2.2.1.5. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

2.2.1.6. Horizontal surfaces: All horizontal surfaces must be dusted and/or washed until free of dust and grime.

2.2.1.7. Furnishings and equipment:

2.2.1.7.1. Remove all gum and sticky substances from all surfaces. Wash all furniture and equipment with a neutral cleaner. Use specialized cleaner appropriate for wood and/or excessively dirty surfaces.

2.2.1.7.2. Dust all machinery and equipment located in any shop area.

2.2.1.7.3. Clean all chalkboards and chalk rails by washing with water and/or chalkboard cleaner. Re-chalk chalkboards after completing cleaning process.

2.2.1.7.4. Clean exterior of all closed lockers and interior of open ones.

2.2.1.7.5. Graffiti must be removed from all furnishings and equipment.

2.2.1.8. Walls: Wash all wall surfaces with detergent and water. Remove all graffiti. All restroom walls should be washed with a disinfectant cleaner.

2.2.1.9. Doors: Wash all doors, frames and hardware.

2.2.1.10. Floors:

2.2.1.10.1. Resilient Floors (except linoleum flooring) – Clean and refinish flooring, using appropriate procedures and finishes/sealers. Strip existing wax from all existing resilient flooring (using appropriate safety measures as recommended by the E.P.A. for any tile containing asbestos) and re-wax as follows:

2.2.1.10.1.1. Classrooms, offices and other rooms - three coats of wax.

2.2.1.10.1.2. Corridors - five coats of wax.

2.2.1.10.1.2.1.1. Newly installed resilient floors should have all surface mastic removed by Design Builder. New floors should be allowed to set for time recommended by manufacturer of mastic. These floors should be scrubbed with detergent -- not stripped. Seal as recommended by flooring manufacturer and re-wax as indicated above.

2.2.1.10.2. Linoleum Floors - Clean and refinish flooring, using appropriate procedures and finishes/sealers in accordance with manufacturers recommendations and finish as follows:

2.2.1.10.2.1.1.1. Newly installed linoleum floors should be allowed to set for time recommended by manufacturer of mastic. Existing and new floors should be scrubbed with a neutral pH (7-8.5) detergent/cleaner – do not strip factory finish. Apply the cleaning solution with a mop and bucket; allow the solution to remain on the floor, and then scrub with a rotary electric scrubber or automatic scrubber with a non-abrasive scrubbing pad. Do not over-saturate the floor. Rinse the entire floor surface with clean, cool water and allow the floor to dry thoroughly before allowing traffic. Apply two (2) coats of “Linobase” sealer,

manufactured by Johnson Diversey or as recommended by manufacturer, followed by three (3) coats of “Carefree” finish, manufactured by Johnson Diversey or as recommended by the manufacturer, per manufacturer’s instructions.

2.2.1.10.3. Concrete Floors - Scrub using water and detergent.

2.2.1.10.4. Ceramic Floors - Scrub using water and detergent.

2.2.1.10.5. Clean, screen and apply gym seal per manufacturer's recommendation. All gym seal to be approved by Custodial Services Department.

2.2.1.10.6. Carpeted Floors - Vacuum all carpets and clean by hot water extraction.

2.2.1.10.7. Other Floors - Marble, terrazzo and rubber floors should be cleaned and refinished using appropriate procedures and finishes/sealers.

2.2.1.11. STAIRS: All stairs to be scrubbed with detergent including walls, handrails and ledges. Finish not to be applied to stairs unless necessary and approved by the District (Custodial Services Department).

2.2.1.12. RESTROOMS AND LOCKER ROOMS: Thoroughly clean and disinfect all surfaces and fixtures. Remove all foreign objects from walls/ceilings and eliminate all graffiti. Specifications provided above for fixtures, walls and floors are applicable.

2.2.1.13. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

2.2.1.14. Sweep concrete floors broom clean in unoccupied spaces.

2.2.1.15. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

2.2.1.16. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

2.2.1.17. Remove labels that are not permanent.

2.2.1.18. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

2.2.1.18.1. Do not paint over “UL” and similar labels, including mechanical and electrical nameplates.

2.2.1.19. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

2.2.1.20. Replace parts subject to unusual operating conditions.

2.2.1.21. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

2.2.1.22. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

2.2.1.23. Clean ducts, blowers, and coils if units were operated without filters during construction.

2.2.1.24. Clean all new and existing light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

2.2.1.25. Leave Project clean and ready for occupancy.

2.3. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Prepare a report.

2.4. Final Inspection: Any surface still exhibiting dirt, graffiti or dust shall be re-cleaned/re-stripped/refinished until free of dirt, graffiti or dust.

2.5. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on District's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove materials from Project site and dispose of lawfully.

END OF SECTION

PART 1 – GENERAL

1. SUMMARY

1.1. Section Includes: Administrative and procedural requirements for contract closeout, including but not limited to, the following:

1.1.1. Substantial Completion requirements.

1.1.2. Inspection (Punch List) procedures.

1.1.3. Final Completion requirements

1.1.4. Project Record Documents.

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1.1.6. Spare parts/materials.

1.1.7. Warranties (Minimum 2 years unless manufacturer's warranty is greater.)

1.1.8. Two-year maintenance and service agreements.

1.1.9. Demonstration and Training of District's personnel.

1.1.10. Final Cleaning.

1.2. Related Sections:

1.2.1. Section 00 50 00 (Form of Agreement) for requirements for Project Completion and Final Payment.
1.2.2. The Conditions for the Contract and the other sections of Division 1 apply to this section as fully as if repeated herein.
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2.1.8. Complete startup testing of systems.

2.1.9. Complete training of the District's staff per Part 3 of this section. Submit training logs and attendance sheets.

2.1.10. Submit test/adjust/balance records.

2.1.11. Properly mount and post all operating instructions.

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2.1.13. For the final phase of the Project and as approved by the District, terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

2.1.14. Advise District of changeover in heat and other utilities.

2.1.15. Submit changeover information related to District's occupancy, use, operation, and maintenance.

2.1.16. Complete final cleaning requirements per Paragraph 3.2, Final Cleaning.

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2.2. Inspection: After all requirements of the Substantial Completion preliminary procedures have been completed, submit a written request for inspection for Substantial Completion. Give notice at least 7 working days in advance from the time the final inspection is to be performed. District will either proceed with inspection or notify Design Builder of unfulfilled requirements. Refer to Paragraph 1.4, List of Incomplete Items (Punch List).

2.2.1. Initial Inspection (Punch List): The Design Builder or his principal superintendent, authorized to act on behalf of the Design Builder, is to assemble a list of unfinished work items and assign costs to each item.

2.2.2. Final Inspection (Punch List): The Design Builder or his principal superintendent, authorized to act on behalf of the Design Builder, shall accompany the District on the final inspection tour. Principal Subcontractors and Consultants that the District may request to be present will also attend. The District will verify the Design Builder's Initial Inspection and recommend any changes.

2.2.3. If the Work has been substantially completed in accordance with the Contract Documents, and only minor corrective measures are required, the District will conditionally accept the Work and will file for the Notice of Completion based upon the Design Builder's assurance that the corrective measures will be completed within the shortest practicable time period.

2.2.4. If the Work has not been substantially completed in accordance with the Contract Documents, and several corrective measures are still required, the District will not accept the Work or record the Notice of Completion. The Design Builder shall complete or correct the items listed on the Initial Inspection and the Final Inspection punch list and then call for a re-inspection, following the procedure outlined above.

2.2.5. Re-inspection: Request for re-inspection when the Work identified in previous inspections as incomplete is completed or corrected. More than one (1) request of the District to make a re-inspection shall be considered an additional service of

District, District's Representative, and/or Inspector of Record, and all subsequent costs will be deducted from the Design Builders final payment.

3. FINAL COMPLETION

3.1. Preliminary Procedures: Before determining the date of Final Completion, complete the following:

3.1.1. Submit a final Application for Payment according to Section 00 50 00 (Agreement).

3.1.2. Submit affidavit of payment of debts and claims.

3.1.3. Submit affidavit of release of liens.

3.1.4. Submit consent of Design Builder's surety to final payment,

3.1.5. Submit complete payroll certifications.

3.1.6. Submit certified copy of District's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by the District's representative. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3.1.7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

3.1.8. Submit pest-control final inspection report and warranty.

3.1.9. Submit all guarantees and warranties. Refer to Paragraph 1.7, Warranties.

3.1.10. Submit all Material Safety Data sheets.

3.1.11. Submit copies of all Verified Reports.

3.1.12. Submit a list of all Subcontractors of every tier providing services and/or materials in connection with the Project, in a formal, adequately bound, cataloged form, which shall include the names, addresses, telephone numbers and fax numbers of such persons, and shall further include notices as to where pertinent persons can and may be reached for emergency service, inclusive of nights, weekends and holidays.

4. DESIGN BUILDER'S LIST OF INCOMPLETE ITEMS (PUNCH LIST)

4.1. Preparation: Submit ten copies of each list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by the Design Builder that are outside the limits of construction.

4.1.1. The list is to be in Microsoft Excel, electronic format. The format is available from the District for the Design Builder's use.

4.1.2. Organize the list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor in each building in the project. Each line item is to have a unique number associated with the room number (do not re-number items once they have been assigned a number).

4.1.3. Organize items by space. Each outstanding item is to be based on the room number where the problem exists and individually numbered.

4.1.4. Include the flowing information at the top of each page:

4.1.4.1.1. Project name.

4.1.4.1.2. Date.

4.1.4.1.3. Name of District's Representative.

4.1.4.1.4. Name of Inspector or Record.

4.1.4.1.5. Name of Design Builder.

4.1.4.1.6. Page Number.

5. PROJECT RECORD DOCUMENTS

5.1. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for the District's representative and Inspector of Record's reference during normal working hours. Submit Record Documents as described in this Section 00 50 00 (Agreement) and 01 11 20 (Design Services and Deliverables).

5.2. Record Drawings: Maintain and submit one signed set of prints of Contract Drawings and Shop Drawings.

5.2.1. Mark Record drawings to show the actual installation where installation varies from that shown originally as well as construction added to the Contract that is not indicated on the Contract Drawings. Require individual or entity who obtained record data, where individual or entity is installer, Subcontractor, or similar entity, to prepare the marked-up Record Prints.

5.2.1.1. Keep Record Drawings current and legible, and available, on site, for inspection at all times by the Inspector of Record, and District's representative.

5.2.1.2. Give particular attention to information on concealed elements that cannot be readily identified and recorded later. Concealed shall mean construction installed underground or in an area which cannot be readily inspected by use of access panels, inspection plates or other removable features.

5.2.1.3. Accurately record information in an understandable drawing technique.

5.2.1.4. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

5.2.1.5. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

5.2.2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

5.2.3. Mark important additional information that was either shown schematically or omitted from original drawings.

5.2.4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, RFI numbers, and similar identification where applicable.

5.2.5. Identify, sign and date each Record Drawing: include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable cover sheets. Include identification on cover sheets.

5.3. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation.

5.3.1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

5.3.2. Mark copy with proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

5.3.3. Note related Change orders, Record Drawings, where applicable.

5.4. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

5.4.1. Include Material Safety Data Sheets.

5.4.2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

5.4.3. Include significant changes in the product delivered to Project site and changes in manufacturer's written instruction for installation.

5.4.4. Note related Change Orders, Record Drawings, where applicable.

6. OPERATIONS AND MAINTENANCE MANUALS

6.1. Assemble 3 copies of complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Section and as follows:

6.1.1. Manufacturer's Manuals: Submit complete installation, operation, maintenance and service manuals, and printed instructions and parts lists for all materials and equipment where such printed matter is regularly available from the manufacturer. This includes, but is not limited to such service manuals as may be sold by the manufacturer covering the operation and maintenance of his items, and complete replacement parts lists sufficiently detailed for parts replacement ordering to manufacturer. Piping diagrams and wiring diagrams are to be included. Bound publications need not be assembled in binders.

6.1.1.1. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title “OPERATION AND MAINTENANCE MANUAL,” Project name, and subject matter of contents.

6.1.2. Equipment Nameplate Data: Submit a typewritten list of all mechanical and electrical equipment showing exact equipment nameplate data. Identify equipment by means of names, symbols, and numbers used in the contract documents

6.1.3. System Operating Instructions: Submit typewritten instructions covering operation of the entire system as installed (not duplicating manufacturer's instructions for operating individual components). Include schematic flow and control diagrams as appropriate and show or list system valves, control elements, and equipment components using identification symbols and numbers, including operating standards. List rooms, area of equipment served, and show proper settings for valves, controls, and switches. Incorporate emergency instructions and procedures, startup and shutdown procedures, seasonal procedures and weekend operations.

6.1.4. System Maintenance Instructions: Submit typewritten instructions covering routine maintenance of system. List each item of equipment requiring inspection, lubrication, or service and briefly describe such maintenance, including types of lubricants and frequency of service. It is not intended that these instructions duplicate manufacturer's detailed instructions. Give name, address and phone number of nearest firm authorized or qualified to service equipment or provide parts

6.1.5. Wall Mounted Data: Frame one set of typewritten system instructions and diagrams as required under Paragraphs .3 and .4 above, covered with glass and mounted in locations as directed by the District. This set of instructions is in addition to the required herein.

7. WARRANTIES & GUARANTEES

7.1. All submitted Warranty and Guaranty forms will be on the Peralta Community College District's Warranty and Guaranty format. Original to be provided.

7.2. Warranties and guarantees for fire/life safety work such as fire alarm, sprinkler, emergency and exit lighting, and exiting pathway systems such as: Elevator, wheelchair lifts, etc. shall have specific language "in the event of our failure to respond and act within 3 hours after being notified in writing by the District, we authorize the District to proceed to have the defects repaired or replaced and made whole, together with any other adjacent work which may be displaced or damaged by so doing, at our expense, and we will honor and pay the costs and charges therefore upon demand. This work shall not invalidate any and all warranties and guarantees."

7.3. Submittal Time: Submit duplicate written warranties and guarantees on request of District for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

7.4. Partial Occupancy: Submit properly executed warranties and guarantees within 15 days of completion of designated portions of the Work that are completed and occupied or used by District during construction period by separate agreement with Design Builder.

7.5. Organize warranty and guarantee documents into an orderly sequence based on the table of contents of the Project Manual.

7.5.1. Bind warranties and guarantees in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to receive 8-1/2-by-11-inch (115-by-280-mm) paper.

7.5.2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty and guarantee. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

7.6. Provide additional copies of each warranty and guarantee to include in operation and maintenance manuals.

PART 2 – PRODUCTS

1. MATERIALS

1.1. Cleaning Agents: Only use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished

surfaces. All cleaners shall be specifically designed for the purpose intended, safe for use on the intended object to be cleaned, and safe to pupils, staff and the public. Refer to the District's standards for cleaning products approved by the District.

1.2. Commercial floor wax stripper, Easterday Ammo-Strip or approved equal, capable of removing metal interlock water emulsion floor finish.

1.3. Floor finish shall be minimum 20% solids content high-gloss wax. Acceptable products:

1.3.1. Spartan Sunny-Side

1.3.2. Spotlight (Brulin Company-800-776-7149)

1.3.3. Champion Once-A-Year

1.4. Graffiti Remover (non-toxic): SO-SAFE BY DX, Inc., or approved equal.

1.5. Germicidal Cleaner must be E.P.A. registered germicidal cleaner and deodorizer appropriate for use in public school buildings. DB team should use PCCD approved COVID-19 Sanitizer.

PART 3 – EXECUTION

1. DEMONSTRATION AND TRAINING

1.1.1. Instruction: After Work under this contract is completed, tested, and before acceptance, and not less than 14 days after submittal of the operation and maintenance data required in Paragraph 1.6, Operations and Maintenance Manuals, operate all systems for a period of three 8-hour days during which time keep on the project competent personnel familiar with the items installed whose full-time assignment will be to instruct the District's maintenance personnel in the operation and maintenance of the equipment and systems.

1.1.2. Provide instructors experienced in operation and maintenance procedures.

1.1.3. Provide instruction at mutually agreed-upon times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.

1.1.4. Schedule training with District, through District's representative, with at least seven days notice.

1.1.5. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

1.1.6. Do not conduct this instruction period before completion of piping and equipment labeling.

1.2. Provide an instruction period sufficient to cover the training required. This instruction period shall be in addition and subsequent to any period of operation, test and adjustment called for elsewhere in this specification.

1.3. Program Structure: develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction of the following:

1.3.1. System design and operational philosophy.

1.3.2. Review of documentation.

1.3.3. Operations.

1.3.4. Adjustments.

1.3.5. Troubleshooting.

1.3.6. Maintenance.

1.3.7. Repair.

2. FINAL AND END-OF-PHASE CLEANING

2.1. General: Provide final cleaning at the completion of each phase of the work and final project completion. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal, State and local environmental and antipollution regulations. If LBP was disturbed during renovation the final cleaning shall meet the minimum requirements of 40 CFR Part 745.

2.2. Cleaning: Employ professional cleaning service for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

2.2.1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for any phase of Project:

2.2.1.1. Clean Project site, yard, and grounds in areas disturbed by construction activities including landscape development areas, of rubbish, waste material, letter, and other foreign substances.

2.2.1.2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

2.2.1.3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

2.2.1.4. Remove tools, construction equipment, machinery, and surplus material from Project site.

2.2.1.5. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

2.2.1.6. Horizontal surfaces: All horizontal surfaces must be dusted and/or washed until free of dust and grime.

2.2.1.7. Furnishings and equipment:

2.2.1.7.1. Remove all gum and sticky substances from all surfaces. Wash all furniture and equipment with a neutral cleaner. Use specialized cleaner appropriate for wood and/or excessively dirty surfaces.

2.2.1.7.2. Dust all machinery and equipment located in any shop area.

2.2.1.7.3. Clean all chalkboards and chalk rails by washing with water and/or chalkboard cleaner. Re-chalk chalkboards after completing cleaning process.

2.2.1.7.4. Clean exterior of all closed lockers and interior of open ones.

2.2.1.7.5. Graffiti must be removed from all furnishings and equipment.

2.2.1.8. Walls: Wash all wall surfaces with detergent and water. Remove all graffiti. All restroom walls should be washed with a disinfectant cleaner.

2.2.1.9. Doors: Wash all doors, frames and hardware.

2.2.1.10. Floors:

2.2.1.10.1. Resilient Floors (except linoleum flooring) – Clean and refinish flooring, using appropriate procedures and finishes/sealers. Strip existing wax from all existing resilient flooring (using appropriate safety measures as recommended by the E.P.A. for any tile containing asbestos) and re-wax as follows:

2.2.1.10.1.1. Classrooms, offices and other rooms - three coats of wax.

2.2.1.10.1.2. Corridors - five coats of wax.

2.2.1.10.1.2.1.1. Newly installed resilient floors should have all surface mastic removed by Design Builder. New floors should be allowed to set for time recommended by manufacturer of mastic. These floors should be scrubbed with detergent -- not stripped. Seal as recommended by flooring manufacturer and re-wax as indicated above.

2.2.1.10.2. Linoleum Floors - Clean and refinish flooring, using appropriate procedures and finishes/sealers in accordance with manufacturers recommendations and finish as follows:

2.2.1.10.2.1.1.1. Newly installed linoleum floors should be allowed to set for time recommended by manufacturer of mastic. Existing and new floors should be scrubbed with a neutral pH (7-8.5) detergent/cleaner – do not strip factory finish. Apply the cleaning solution with a mop and bucket; allow the solution to remain on the floor, and then scrub with a rotary electric scrubber or automatic scrubber with a non-abrasive scrubbing pad. Do not over-saturate the floor. Rinse the entire floor surface with clean, cool water and allow the floor to dry thoroughly before allowing traffic. Apply two (2) coats of “Linobase” sealer,

manufactured by Johnson Diversey or as recommended by manufacturer, followed by three (3) coats of “Carefree” finish, manufactured by Johnson Diversey or as recommended by the manufacturer, per manufacturer’s instructions.

2.2.1.10.3. Concrete Floors - Scrub using water and detergent.

2.2.1.10.4. Ceramic Floors - Scrub using water and detergent.

2.2.1.10.5. Clean, screen and apply gym seal per manufacturer's recommendation. All gym seal to be approved by Custodial Services Department.

2.2.1.10.6. Carpeted Floors - Vacuum all carpets and clean by hot water extraction.

2.2.1.10.7. Other Floors - Marble, terrazzo and rubber floors should be cleaned and refinished using appropriate procedures and finishes/sealers.

2.2.1.11. STAIRS: All stairs to be scrubbed with detergent including walls, handrails and ledges. Finish not to be applied to stairs unless necessary and approved by the District (Custodial Services Department).

2.2.1.12. RESTROOMS AND LOCKER ROOMS: Thoroughly clean and disinfect all surfaces and fixtures. Remove all foreign objects from walls/ceilings and eliminate all graffiti. Specifications provided above for fixtures, walls and floors are applicable.

2.2.1.13. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

2.2.1.14. Sweep concrete floors broom clean in unoccupied spaces.

2.2.1.15. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

2.2.1.16. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

2.2.1.17. Remove labels that are not permanent.

2.2.1.18. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

2.2.1.18.1. Do not paint over “UL” and similar labels, including mechanical and electrical nameplates.

2.2.1.19. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

2.2.1.20. Replace parts subject to unusual operating conditions.

2.2.1.21. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

2.2.1.22. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

2.2.1.23. Clean ducts, blowers, and coils if units were operated without filters during construction.

2.2.1.24. Clean all new and existing light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

2.2.1.25. Leave Project clean and ready for occupancy.

2.3. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Prepare a report.

2.4. Final Inspection: Any surface still exhibiting dirt, graffiti or dust shall be re-cleaned/re-stripped/refinished until free of dirt, graffiti or dust.

2.5. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on District's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove materials from Project site and dispose of lawfully.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 This section describes field engineering services to be performed by Design Builder and by District, and procedures to accomplish these services.

1.1.2 Related Documents.

1.1.2.1 Document 00 33 50 Existing Site Conditions.

1.1.3 Related Sections.

1.1.3.1 Section 01 11 13 (Work Covered by Contract Documents).

1.1.3.2 Section 01 11 20 (Design Services and Deliverables).

1.1.3.3 Section 01 31 19 (Project Meetings).

1.2 RESPONSIBILITIES

1.2.1 Design Builder shall provide field engineering services; establish grades, lines, and levels for Work by use of recognized engineering survey practices.

1.2.2 Design Builder shall employ California licensed civil engineer or land surveyor for horizontal and vertical control.

1.2.3 District will provide reference points for horizontal and vertical control and shall provide starting points for the Work.

1.3 PROCEDURES

1.3.1 Design Builder shall request assistance from District two (2) Business Days prior to date assistance is required.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION (Not used)

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

1.1.1 This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1.1.1.1 Construction layout.

1.1.1.2 Field engineering and surveying.

1.1.1.3 General installation of products.

1.1.1.4 Coordination of District-installed products.

1.1.1.5 Progress cleaning.

1.1.1.6 Starting and adjusting.

1.1.1.7 Protection of installed construction.

1.1.1.8 Correction of the Work.

1.1.2 Related Sections include the following:

1.1.2.1 Section 00 33 50 (Existing Site Conditions).

1.1.2.2 Section 01 11 13 (Work Covered by Contract Documents).

1.1.2.3 Section 01 14 00 (Work Restrictions) regarding measures for noise, dust and infection control.

1.1.2.4 Section 01 31 00 (Project Management and Coordination) for procedures for coordinating field engineering with other construction activities.

1.1.2.5 Section 01 31 19 (Project Meetings).

1.1.2.6 Section 01 33 00 (Submittal Procedures) for submitting surveys.

1.1.2.7 Section 01 73 29 (Cutting and Patching) for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.

1.1.2.8 Section 01 77 00 (Cleaning and Closeout Procedures) for submitting final property survey with Project Record Documents, recording of District-accepted deviations from indicated lines and levels, and final cleaning.

1.2 SUBMITTALS

1.2.1 Qualification Data: For land surveyor or professional engineer.

1.2.2 Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

1.2.3 Certified Surveys: Submit three copies signed by land surveyor or professional engineer and one AutoCad electronic file of survey complying with District CAD Standards on CD-R.

1.2.4 Final Property Survey: Submit three copies showing the Work performed and record survey data and one AutoCad electronic file of survey complying with District CAD Standards on CD-R.

1.2.5 Contingency Plan: Submit six copies within sixty (60) Days of Notice to Proceed for emergency plan(s) should an existing utility be damaged.

1.3 QUALITY ASSURANCE

1.3.1 Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in California and who is experienced in providing land-surveying services of the kind indicated.

1.3.2 Installer Qualifications.

1.3.2.1 Experienced Installers: Installers shall have a minimum of five (5) years successful experience installing items similar to those required for Project, except for individuals in training under the direct supervision of an experienced installer.

1.3.3 If cleaning and protection is not performed to the satisfaction of the District's Representative, the District reserves the right to have cleaning performed by others at the Design Builder's expense.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

3.1.1 Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and locations of underground utilities and other construction affecting the Work.

3.1.1.1 Before construction, verify the locations and invert elevations at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

3.1.1.2 Furnish location data for work related to Project that must be performed by public utilities serving Project site.

3.1.1.3 Locate all known existing utilities and shut-off devices before proceeding with construction operations that may cause damage to such installations. Existing utilities shall be kept in service where possible and damage to them shall be repaired with no adjustment to the Stipulated Sum.

3.1.1.4 If any other structures or utilities are encountered, request District's Representative to provide direction on how to proceed with the Work.

3.1.1.5 If any structure or utility is damaged, take appropriate action to ensure the safety of persons and property.

3.1.1.6 Submit a contingency plan for emergency repair of all utilities to District's Representative for approval prior to commencing Work.

3.1.2 Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

3.1.2.1 Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

3.1.2.1.1 Description of the Work.

3.1.2.1.2 List of detrimental conditions, including substrates.

3.1.2.1.3 List of unacceptable installation tolerances.

3.1.2.1.4 Recommended corrections.

3.1.2.2 Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3.1.2.3 Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

3.1.2.4 Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

3.1.2.5 Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 MANUFACTURERS' INSTRUCTIONS

3.2.1 Manufacturer's Recommendations: When work is specified to comply with manufacturers' recommendations or instructions, distribute copies to persons involved, and maintain one set in field office.

3.2.1.1 Conform with requirements specified in Section 01 33 00 (Submittal Procedures) for submittal of recommendations or instructions to District; submit to District only where specified or where specifically requested.

3.2.2 Perform work in accordance with details of recommendations and instructions and specified requirements.

3.2.2.1 Should a conflict exist between Specifications and recommendations or instructions consult with District.

3.2.3 Where manufacturer's information notes special recommendations in addition to installation instructions, comply with both recommendations and instructions.

3.3 PREPARATION

3.3.1 Existing Utility Information: Furnish public utilities with information that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with District's Representative.

3.3.2 Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

3.3.2.1 Where portions of Work are to fit to other construction, verify dimensions of other construction by field measurements before fabrication; allow for cutting and patching to avoid delaying Work.

3.3.3 Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

3.3.4 Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to District's Representative. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on Form, "Request for Information."

3.4 CONSTRUCTION LAYOUT

3.4.1 Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify District's Representative promptly.

3.4.2 General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.

3.4.2.1 Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.

3.4.2.2 Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3.4.2.3 Inform installers of lines and levels to which they must comply.

3.4.2.4 Check the location, level, and plumb of every major element as the Work progresses.

3.4.2.5 Notify District's Representative when deviations from required lines and levels exceed allowable tolerances.

3.4.2.6 Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

3.4.3 Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

3.4.4 Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

3.4.5 Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by District's Representative.

3.5 FIELD ENGINEERING

3.5.1 Identification: District will provide reference points for horizontal and vertical control and shall provide starting points for the Work.

3.5.2 47Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

3.5.2.1 Do not change or relocate existing benchmarks or control points without prior written approval of District's Representative. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to District's Representative before proceeding.

3.5.2.2 Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

3.5.3 Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

3.5.3.1 Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

3.5.3.2 Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3.5.3.3 Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5.4 Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

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3.6.2 General: Locate the Work and components of the Work accurately, in correct alignment and elevation.

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3.6.2.2 Install components to maximize space available for maintenance and ease of removal for replacement.

3.6.2.3 Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

3.6.2.4 Doors and access panels shall be kept clear.

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3.6.2.6 Relocate installed work that does not provide adequate accessibility.

3.6.2.7 Maintain minimum headroom clearance of eight (8) feet in spaces without a suspended ceiling.

3.6.2.8 Do not obstruct spaces and installations that are required to be clear by California Building Code requirements.

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3.6.3.2 Product listing, classification or certification.

3.6.3.3 Manufacturer's installation instructions.

3.6.3.4 Trade association or referenced standards.

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3.7.2.1 Contract Schedule: Inform District of Design Builder's preferred contract Schedule for District's portion of the Work. Adjust Contract Schedule based on a mutually agreeable timetable. Notify District if changes to schedule are required due to differences in actual construction progress.

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3.8.1 General: Clean Project site and work areas at frequent intervals, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully. Comply with the requirements of Section 01 77 00 (Cleaning and Closeout Procedures).

3.8.1.1 Comply with requirements in CFC Article 87 for removal of combustible waste materials and debris.

3.8.1.2 Do not hold materials more than seven (7) days during normal weather or three (3) Days if the temperature is expected to rise above eighty degrees Fahrenheit (80°F).

3.8.1.3 Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

3.8.2 Site: Maintain Project site free of waste materials and debris.

3.8.3 Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

3.8.3.1 Remove liquid spills promptly.

3.8.3.2 Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate. Refer to Section 01140 (Work Restrictions) regarding dust and infection control requirements.

3.8.4 Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

3.8.5 Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

3.8.6 Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

3.8.7 Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

3.8.8 During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

3.8.9 Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

3.8.10 Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

3.8.10.1 Excessive static or dynamic loading.

3.8.10.2 Excessive internal or external pressures.

3.8.10.3 Excessively high or low temperatures.

3.8.10.4 Thermal shock.

3.8.10.5 Excessively high or low humidity.

3.8.10.6 Air contamination or pollution.

3.8.10.7 Water or ice.

3.8.10.8 Solvents.

3.8.10.9 Chemicals.

3.8.10.10 Light.

3.8.10.11 Puncture.

3.8.10.12 Abrasion.

3.8.10.13 Heavy traffic.

3.8.10.14 Soiling, staining and corrosion.

3.8.10.15 Bacteria.

3.8.10.16 Rodent and insect infestation.

3.8.10.17 Combustion.

3.8.10.18 Electrical current.

3.8.10.19 High speed operation.

3.8.10.20 Improper lubrication.

3.8.10.21 Unusual wear or other misuse.

3.8.10.22 Contact between incompatible materials.

3.8.10.23 Destructive testing.

3.8.10.24 Misalignment.

3.8.10.25 Excessive weathering.

3.8.10.26 Unprotected storage.

3.8.10.27 Improper shipping or handling.

3.8.10.28 Theft.

3.8.10.29 Vandalism.

3.9 STARTING AND ADJUSTING

3.9.1 Following are minimum starting and adjusting requirements. Design Builder is to perform starting and adjusting per manufacturer's recommendations. If more

stringent requirements are described in the Contract Documents, the more stringent shall apply

3.9.1.1 Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

3.9.1.2 Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

3.9.1.3 Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.9.1.4 Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01 45 00 (Quality Control).

3.10 PROTECTION OF INSTALLED CONSTRUCTION

3.10.1 Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

3.10.1.1 Cover products subject to deterioration with impervious cover; provide ventilation to avoid condensation and trapping water.

3.10.1.2 Take care to use protective covering and blocking materials that do not soil, stain, or damage materials being protected.

3.10.1.3 After installation, provide coverings to protect products from damage from traffic and construction operations, remove when no longer needed.

3.10.2 Comply with manufacturer's written instructions for temperature and relative humidity.

3.10.3 Protect interior materials from water damage; immediately remove wet materials from site to prevent growth of mold and mildew on site.

3.10.4 Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

3.11 CORRECTION OF THE WORK

3.11.1 Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01 73 29 (Cutting and Patching).

3.11.1.1 Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

3.11.2 Restore permanent facilities used during construction to their specified condition.

3.11.3 Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

3.11.4 Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

3.11.5 Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

1.1.1 This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1.1.1.1 Construction layout.

1.1.1.2 Field engineering and surveying.

1.1.1.3 General installation of products.

1.1.1.4 Coordination of District-installed products.

1.1.1.5 Progress cleaning.

1.1.1.6 Starting and adjusting.

1.1.1.7 Protection of installed construction.

1.1.1.8 Correction of the Work.

1.1.2 Related Sections include the following:

1.1.2.1 Section 00 33 50 (Existing Site Conditions).

1.1.2.2 Section 01 11 13 (Work Covered by Contract Documents).

1.1.2.3 Section 01 14 00 (Work Restrictions) regarding measures for noise, dust and infection control.

1.1.2.4 Section 01 31 00 (Project Management and Coordination) for procedures for coordinating field engineering with other construction activities.

1.1.2.5 Section 01 31 19 (Project Meetings).

1.1.2.6 Section 01 33 00 (Submittal Procedures) for submitting surveys.

1.1.2.7 Section 01 73 29 (Cutting and Patching) for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.

1.1.2.8 Section 01 77 00 (Cleaning and Closeout Procedures) for submitting final property survey with Project Record Documents, recording of District-accepted deviations from indicated lines and levels, and final cleaning.

1.2 SUBMITTALS

1.2.1 Qualification Data: For land surveyor or professional engineer.

1.2.2 Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

1.2.3 Certified Surveys: Submit three copies signed by land surveyor or professional engineer and one AutoCad electronic file of survey complying with District CAD Standards on CD-R.

1.2.4 Final Property Survey: Submit three copies showing the Work performed and record survey data and one AutoCad electronic file of survey complying with District CAD Standards on CD-R.

1.2.5 Contingency Plan: Submit six copies within sixty (60) Days of Notice to Proceed for emergency plan(s) should an existing utility be damaged.

1.3 QUALITY ASSURANCE

1.3.1 Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in California and who is experienced in providing land-surveying services of the kind indicated.

1.3.2 Installer Qualifications.

1.3.2.1 Experienced Installers: Installers shall have a minimum of five (5) years successful experience installing items similar to those required for Project, except for individuals in training under the direct supervision of an experienced installer.

1.3.3 If cleaning and protection is not performed to the satisfaction of the District's Representative, the District reserves the right to have cleaning performed by others at the Design Builder's expense.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

3.1.1 Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and locations of underground utilities and other construction affecting the Work.

3.1.1.1 Before construction, verify the locations and invert elevations at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

3.1.1.2 Furnish location data for work related to Project that must be performed by public utilities serving Project site.

3.1.1.3 Locate all known existing utilities and shut-off devices before proceeding with construction operations that may cause damage to such installations. Existing utilities shall be kept in service where possible and damage to them shall be repaired with no adjustment to the Stipulated Sum.

3.1.1.4 If any other structures or utilities are encountered, request District's Representative to provide direction on how to proceed with the Work.

3.1.1.5 If any structure or utility is damaged, take appropriate action to ensure the safety of persons and property.

3.1.1.6 Submit a contingency plan for emergency repair of all utilities to District's Representative for approval prior to commencing Work.

3.1.2 Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

3.1.2.1 Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

3.1.2.1.1 Description of the Work.

3.1.2.1.2 List of detrimental conditions, including substrates.

3.1.2.1.3 List of unacceptable installation tolerances.

3.1.2.1.4 Recommended corrections.

3.1.2.2 Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3.1.2.3 Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

3.1.2.4 Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

3.1.2.5 Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 MANUFACTURERS' INSTRUCTIONS

3.2.1 Manufacturer's Recommendations: When work is specified to comply with manufacturers' recommendations or instructions, distribute copies to persons involved, and maintain one set in field office.

3.2.1.1 Conform with requirements specified in Section 01 33 00 (Submittal Procedures) for submittal of recommendations or instructions to District; submit to District only where specified or where specifically requested.

3.2.2 Perform work in accordance with details of recommendations and instructions and specified requirements.

3.2.2.1 Should a conflict exist between Specifications and recommendations or instructions consult with District.

3.2.3 Where manufacturer's information notes special recommendations in addition to installation instructions, comply with both recommendations and instructions.

3.3 PREPARATION

3.3.1 Existing Utility Information: Furnish public utilities with information that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with District's Representative.

3.3.2 Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

3.3.2.1 Where portions of Work are to fit to other construction, verify dimensions of other construction by field measurements before fabrication; allow for cutting and patching to avoid delaying Work.

3.3.3 Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

3.3.4 Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to District's Representative. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on Form, "Request for Information."

3.4 CONSTRUCTION LAYOUT

3.4.1 Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify District's Representative promptly.

3.4.2 General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.

3.4.2.1 Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.

3.4.2.2 Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3.4.2.3 Inform installers of lines and levels to which they must comply.

3.4.2.4 Check the location, level, and plumb of every major element as the Work progresses.

3.4.2.5 Notify District's Representative when deviations from required lines and levels exceed allowable tolerances.

3.4.2.6 Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

3.4.3 Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

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3.8.7 Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

3.8.8 During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

3.8.9 Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

3.8.10 Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

3.8.10.1 Excessive static or dynamic loading.

3.8.10.2 Excessive internal or external pressures.

3.8.10.3 Excessively high or low temperatures.

3.8.10.4 Thermal shock.

3.8.10.5 Excessively high or low humidity.

3.8.10.6 Air contamination or pollution.

3.8.10.7 Water or ice.

3.8.10.8 Solvents.

3.8.10.9 Chemicals.

3.8.10.10 Light.

3.8.10.11 Puncture.

3.8.10.12 Abrasion.

3.8.10.13 Heavy traffic.

3.8.10.14 Soiling, staining and corrosion.

3.8.10.15 Bacteria.

3.8.10.16 Rodent and insect infestation.

3.8.10.17 Combustion.

3.8.10.18 Electrical current.

3.8.10.19 High speed operation.

3.8.10.20 Improper lubrication.

3.8.10.21 Unusual wear or other misuse.

3.8.10.22 Contact between incompatible materials.

3.8.10.23 Destructive testing.

3.8.10.24 Misalignment.

3.8.10.25 Excessive weathering.

3.8.10.26 Unprotected storage.

3.8.10.27 Improper shipping or handling.

3.8.10.28 Theft.

3.8.10.29 Vandalism.

3.9 STARTING AND ADJUSTING

3.9.1 Following are minimum starting and adjusting requirements. Design Builder is to perform starting and adjusting per manufacturer's recommendations. If more

stringent requirements are described in the Contract Documents, the more stringent shall apply

3.9.1.1 Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

3.9.1.2 Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

3.9.1.3 Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.9.1.4 Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01 45 00 (Quality Control).

3.10 PROTECTION OF INSTALLED CONSTRUCTION

3.10.1 Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

3.10.1.1 Cover products subject to deterioration with impervious cover; provide ventilation to avoid condensation and trapping water.

3.10.1.2 Take care to use protective covering and blocking materials that do not soil, stain, or damage materials being protected.

3.10.1.3 After installation, provide coverings to protect products from damage from traffic and construction operations, remove when no longer needed.

3.10.2 Comply with manufacturer's written instructions for temperature and relative humidity.

3.10.3 Protect interior materials from water damage; immediately remove wet materials from site to prevent growth of mold and mildew on site.

3.10.4 Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

3.11 CORRECTION OF THE WORK

3.11.1 Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01 73 29 (Cutting and Patching).

3.11.1.1 Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

3.11.2 Restore permanent facilities used during construction to their specified condition.

3.11.3 Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

3.11.4 Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

3.11.5 Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for salvaging, recycling and disposing of nonhazardous demolition and construction waste.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements
2. Section 02 41 16 Structure Demolition
3. Section 02 41 19 Selective Demolition
4. Division 31 – Site Clearing

1.2 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.

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.

G. USGBC: United States Green Building Council.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Comply with Section 01 81 13 – Sustainable Design Requirements.

B. Unless otherwise indicated, demolition and construction waste becomes the property of Contractor.

C. Any items identified in other Sections, historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during

demolition remain the property of Owner. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PERFORMANCE REQUIREMENTS

A. Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Construction Waste:
    a. Masonry.
    b. Lumber.
    c. Wood sheet materials.
    d. Wood trim.
    e. Metals.
    f. Roofing.
    g. Insulation.
    h. Carpet and pad.
    i. Gypsum board.
    j. Piping.
    k. Electrical conduit.
    l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
        i. Paper.
        ii. Cardboard.
        iii. Boxes.
        iv. Plastic sheet and film.
        v. Polystyrene packaging.
        vi. Wood crates.
        vii. Wood pallets.
        viii. Plastic pails.
2. Demolition Waste:
    a. Asphalt paving.
    b. Concrete and Concrete Masonry Units.
    c. Concrete reinforcing steel.

d. Brick.
e. Concrete masonry units.
f. Wood studs.
g. Wood joists.
h. Plywood and oriented strand board.
i. Wood paneling.
j. Wood trim.
k. Structural and miscellaneous steel.
l. Rough hardware.
m. Roofing.
n. Insulation.
o. Doors and frames.
p. Door hardware.
q. Windows.
r. Glazing.
s. Metal studs.
t. Gypsum board.
u. Acoustical tile and panels.
v. Carpet.
w. Carpet pad.
x. Demountable partitions.
y. Equipment.
z. Cabinets.
aa. Plumbing fixtures.
bb. Piping.
cc. Supports and hangers.
dd. Valves.
ee. Sprinklers.
ff. Mechanical equipment.
gg. Refrigerants.
hh. Electrical conduit.
ii. Copper wiring.
jj. Lighting fixtures.
kk. Lamps.

ll. Ballasts.

mm. Electrical devices.

nn. Switchgear and panelboards.

oo. Transformers.

1.4 SUBMITTALS

A. Waste Management Plan: Submit plan in compliance with Section 01 81 13.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use forms necessary to clearly provide the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Substantial Completion: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

1. When specified in other Sections, upload submission directly to USGBC online project site.
2. Maintain records of the following:

a. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

b. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

c. 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.

d. 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.

D. Refrigerant Recovery: Comply with requirements in Section 02 41 16 – Structure Demolition.

1.5 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements.

B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition 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 in compliance with Section 02 41 16 - Structure Demolition.

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 where materials separation will be performed.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.1 PLAN IMPLEMENTATION

A. Implement approved waste management plan. Provide specific areas for separating materials that are to be salvaged and recycled, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract. Comply with Division 1 – Temporary Facilities and Controls.

B. Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

C. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.2 SALVAGING AND RECYCLING DEMOLITION WASTE

A. Comply with requirements in Section 02 41 16 - Structure Demolition.

3.3 RECYCLING CONSTRUCTION WASTE

A. 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 Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin. Remove any contaminated materials found in bins.

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. Store components off the ground and protect from the weather.

4. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

E. Package Recycling:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.

2. Polystyrene Packaging: Separate and bag materials.

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.

F. Wood Material Recycling:

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 or in container and store in a dry location.

H. Paint: Seal containers and store by type.

3.4 DISPOSAL OF WASTE

A. Except for items or materials to be salvaged or recycled, 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.

END OF SECTION

PART 1 – GENERAL

1. SUMMARY

1.1. Section Includes: Administrative and procedural requirements for contract closeout, including but not limited to, the following:

1.1.1. Substantial Completion requirements.

1.1.2. Inspection (Punch List) procedures.

1.1.3. Final Completion requirements

1.1.4. Project Record Documents.

1.1.5. Operations and Maintenance Manuals

1.1.6. Spare parts/materials.

1.1.7. Warranties (Minimum 2 years unless manufacturer's warranty is greater.)

1.1.8. Two-year maintenance and service agreements.

1.1.9. Demonstration and Training of District's personnel.

1.1.10. Final Cleaning.

1.2. Related Sections:

1.2.1. Section 00 50 00 (Form of Agreement) for requirements for Project Completion and Final Payment.
1.2.2. The Conditions for the Contract and the other sections of Division 1 apply to this section as fully as if repeated herein.
1.2.3. Divisions 2 through 33 Sections for specific closeout and special cleaning requirements for products of those sections.

2. SUBSTANTIAL COMPLETION

2.1. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion by phase, complete the following. List items below that are incomplete in request.

2.1.1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list and reasons why the Work is not complete.

2.1.2. For the final phase of the Project, advise the District of pending insurance changeover requirements.

2.1.3. For the final phase of the Project, submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

2.1.4. Obtain and submit releases permitting District unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

2.1.5. For the final phase of the Project, prepare, sign, and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs (and photographic negatives or a disk with all digital files), damage or settlement surveys, property surveys, and similar final record information. Deliver operation and maintenance manuals and Project Record Documents at least two weeks (14 days) before training and request for Substantial Completion Inspection.

2.1.6. For the final phase of the Project, deliver all tools, spare parts, extra materials, and similar items that are a permanent part of the installed equipment, to the District. Label with manufacturer's name and model number where applicable.

2.1.7. All plumbing and mechanical equipment shall operate quietly and free from vibration. Properly adjust, repair, balance, or replace equipment producing objectionable noise or vibration. Provide additional brackets, bracing, or other methods to prevent objectionable noise or vibration. All systems shall operate without humming, surging, or rapid cycling.

2.1.8. Complete startup testing of systems.

2.1.9. Complete training of the District's staff per Part 3 of this section. Submit training logs and attendance sheets.

2.1.10. Submit test/adjust/balance records.

2.1.11. Properly mount and post all operating instructions.

2.1.12. Make final changeover of permanent locks and deliver properly marked keys to District. Advise District 's personnel of changeover in security provisions.

2.1.13. For the final phase of the Project and as approved by the District, terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

2.1.14. Advise District of changeover in heat and other utilities.

2.1.15. Submit changeover information related to District's occupancy, use, operation, and maintenance.

2.1.16. Complete final cleaning requirements per Paragraph 3.2, Final Cleaning.

2.1.17. Touch up and otherwise repair and restore marred and exposed finishes to eliminate visual defects.

2.1.18. Deliver evidence of compliance with any and all requirements of all applicable governmental regulatory agencies at all levels, including District, City, State (DSA and Emergency Planning Department) and Federal government and agencies.

2.1.19. Submit certificates of inspection for vertical transportation systems, and life safety systems.

2.1.20. Submit copies of the fire alarm certification.

2.1.21. Certificates: For the final phase of the Project, submit manufacturer's representative's certification that work has been installed in accordance with manufacturer's recommendations.

2.1.22. Complete all Testing requirements per Section 01 88 20 (Miscellaneous Hazardous Materials Requirements).

2.2. Inspection: After all requirements of the Substantial Completion preliminary procedures have been completed, submit a written request for inspection for Substantial Completion. Give notice at least 7 working days in advance from the time the final inspection is to be performed. District will either proceed with inspection or notify Design Builder of unfulfilled requirements. Refer to Paragraph 1.4, List of Incomplete Items (Punch List).

2.2.1. Initial Inspection (Punch List): The Design Builder or his principal superintendent, authorized to act on behalf of the Design Builder, is to assemble a list of unfinished work items and assign costs to each item.

2.2.2. Final Inspection (Punch List): The Design Builder or his principal superintendent, authorized to act on behalf of the Design Builder, shall accompany the District on the final inspection tour. Principal Subcontractors and Consultants that the District may request to be present will also attend. The District will verify the Design Builder's Initial Inspection and recommend any changes.

2.2.3. If the Work has been substantially completed in accordance with the Contract Documents, and only minor corrective measures are required, the District will conditionally accept the Work and will file for the Notice of Completion based upon the Design Builder's assurance that the corrective measures will be completed within the shortest practicable time period.

2.2.4. If the Work has not been substantially completed in accordance with the Contract Documents, and several corrective measures are still required, the District will not accept the Work or record the Notice of Completion. The Design Builder shall complete or correct the items listed on the Initial Inspection and the Final Inspection punch list and then call for a re-inspection, following the procedure outlined above.

2.2.5. Re-inspection: Request for re-inspection when the Work identified in previous inspections as incomplete is completed or corrected. More than

one (1) request of the District to make a re-inspection shall be considered an additional service of District, District's Representative, and/or Inspector of Record, and all subsequent costs will be deducted from the Design Builders final payment.

3. FINAL COMPLETION

3.1. Preliminary Procedures: Before determining the date of Final Completion, complete the following:

3.1.1. Submit a final Application for Payment according to Section 00 50 00 (Form of Agreement).

3.1.2. Submit affidavit of payment of debts and claims.

3.1.3. Submit affidavit of release of liens.

3.1.4. Submit consent of Design Builder's surety to final payment,

3.1.5. Submit complete payroll certifications.

3.1.6. Submit certified copy of District's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by the District's representative. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3.1.7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

3.1.8. Submit pest-control final inspection report and warranty.

3.1.9. Submit all guarantees and warranties. Refer to Paragraph 1.7, Warranties.

3.1.10. Submit all Material Safety Data sheets.

3.1.11. Submit copies of all Verified Reports.

3.1.12. Submit a list of all Subcontractors of every tier providing services and/or materials in connection with the Project, in a formal, adequately bound, cataloged form, which shall include the names, addresses, telephone numbers and fax numbers of such persons, and shall further include notices as to where pertinent persons can and may be reached for emergency service, inclusive of nights, weekends and holidays.

4. DESIGN BUILDER'S LIST OF INCOMPLETE ITEMS (PUNCH LIST)

4.1. Preparation: Submit ten copies of each list. Include name and identification of each space and area affected by construction operations for incomplete items and items

needing correction including, if necessary, areas disturbed by the Design Builder that are outside the limits of construction.

4.1.1. The list is to be in Microsoft Excel, electronic format. The format is available from the District for the Design Builder's use.

4.1.2. Organize the list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor in each building in the project. Each line item is to have a unique number associated with the room number (do not re-number items once they have been assigned a number).

4.1.3. Organize items by space. Each outstanding item is to be based on the room number where the problem exists and individually numbered.

4.1.4 Include the flowing information at the top of each page:

4.1.3.1.1. Project name.

4.1.3.1.2. Date.

4.1.3.1.3. Name of District's Representative.

4.1.3.1.4. Name of Inspector or Record.

4.1.3.1.5. Name of Design Builder.

4.1.3.1.6. Page Number.

5. PROJECT RECORD DOCUMENTS

5.1. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for the District's representative and Inspector of Record's reference during normal working hours. Submit Record Documents as described in this Section 00 50 00 (Form of Agreement) and 01 11 20 (Design Services and Deliverables).

5.2. Record Drawings: Maintain and submit one signed set of prints of Contract Drawings and Shop Drawings.

5.2.1. Mark Record drawings to show the actual installation where installation varies from that shown originally as well as construction added to the Contract that is not indicated on the Contract Drawings. Require individual or entity who obtained record data, where individual or entity is installer, Subcontractor, or similar entity, to prepare the marked-up Record Prints.

5.2.1.1. Keep Record Drawings current and legible, and available, on site, for inspection at all times by the Inspector of Record, and District's representative.

5.2.1.2. Give particular attention to information on concealed elements that cannot be readily identified and recorded later. Concealed shall mean construction installed underground or in an area which cannot be readily inspected by use of access panels, inspection plates or other removable features.

5.2.1.3. Accurately record information in an understandable drawing technique.

5.2.1.4. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

5.2.1.5. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

5.2.2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

5.2.3. Mark important additional information that was either shown schematically or omitted from original drawings.

5.2.4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, RFI numbers, and similar identification where applicable.

5.2.5. Identify, sign and date each Record Drawing: include the designation “PROJECT RECORD DRAWING” in a prominent location. Organize into manageable sets; bind each set with durable cover sheets. Include identification on cover sheets.

5.3. Record Specifications: Submit one copy of Project’s Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation.

5.3.1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

5.3.2. Mark copy with proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

5.3.3. Note related Change orders, Record Drawings, where applicable.

5.4. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

5.4.1. Include Material Safety Data Sheets.

5.4.2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

5.4.3. Include significant changes in the product delivered to Project site and changes in manufacturer's written instruction for installation.

5.4.4. Note related Change Orders, Record Drawings, where applicable.

6. OPERATIONS AND MAINTENANCE MANUALS

6.1. Assemble 3 copies of complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Section and as follows:

6.1.1. Manufacturer's Manuals: Submit complete installation, operation, maintenance and service manuals, and printed instructions and parts lists for all materials and equipment where such printed matter is regularly available from the manufacturer. This includes, but is not limited to such service manuals as may be sold by the manufacturer covering the operation and maintenance of his items, and complete replacement parts lists sufficiently detailed for parts replacement ordering to manufacturer. Piping diagrams and wiring diagrams are to be included. Bound publications need not be assembled in binders.

6.1.1.1. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

6.1.2. Equipment Nameplate Data: Submit a typewritten list of all mechanical and electrical equipment showing exact equipment nameplate data. Identify equipment by means of names, symbols, and numbers used in the contract documents

6.1.3. System Operating Instructions: Submit typewritten instructions covering operation of the entire system as installed (not duplicating manufacturer's instructions for operating individual components). Include schematic flow and control diagrams as appropriate and show or list system valves, control elements, and equipment components using identification symbols and numbers, including operating standards. List rooms, area of equipment served, and show proper settings for valves, controls, and switches. Incorporate emergency instructions and procedures, startup and shutdown procedures, seasonal procedures and weekend operations.

6.1.4. System Maintenance Instructions: Submit typewritten instructions covering routine maintenance of system. List each item of equipment

requiring inspection, lubrication, or service and briefly describe such maintenance, including types of lubricants and frequency of service. It is not intended that these instructions duplicate manufacturer's detailed instructions. Give name, address and phone number of nearest firm authorized or qualified to service equipment or provide parts

6.1.5. Wall Mounted Data: Frame one set of typewritten system instructions and diagrams as required under Paragraphs .3 and .4 above, covered with glass and mounted in locations as directed by the District. This set of instructions is in addition to the required herein.

7. WARRANTIES & GUARANTEES

7.1. See Section 00 62 00 (Guaranty) form and 00 62 50 (Certificate of Warranty) for warranty form. All submitted Warranty and Guaranty forms will be on the Peralta Community College District's Warranty and Guaranty format. Originals to be provided.

7.2. Warranties and guarantees for fire/life safety work such as fire alarm, sprinkler, emergency and exit lighting, and exiting pathway systems such as: Elevator, wheelchair lifts, etc. shall have specific language "in the event of our failure to respond and act within 3 hours after being notified in writing by the District, we authorize the District to proceed to have the defects repaired or replaced and made whole, together with any other adjacent work which may be displaced or damaged by so doing, at our expense, and we will honor and pay the costs and charges therefore upon demand. This work shall not invalidate any and all warranties and guarantees."

7.3. Submittal Time: Submit duplicate written warranties and guarantees on request of District for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

7.4. Partial Occupancy: Submit properly executed warranties and guarantees within 15 days of completion of designated portions of the Work that are completed and occupied or used by District during construction period by separate agreement with Design Builder.

7.5. Organize warranty and guarantee documents into an orderly sequence based on the table of contents of the Project Manual.

7.5.1. Bind warranties and guarantees in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to receive 8-1/2-by-11-inch (115-by-280-mm) paper.

7.5.2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty and guarantee. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

7.6. Provide additional copies of each warranty and guarantee to include in operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Only use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces. All cleaners shall be specifically designed for the purpose intended, safe for use on the intended object to be cleaned, and safe to pupils, staff and the public. Refer to the District's standards for cleaning products approved by the District.

B. Commercial floor wax stripper, Easterday Ammo-Strip or approved equal, capable of removing metal interlock water emulsion floor finish.

C. Floor finish shall be minimum 20% solids content high-gloss wax. Acceptable products:

1. Spartan Sunny-Side

2. Spotlight (Brulin Company-800-776-7149)

3. Champion Once-A-Year

Graffiti Remover (non-toxic): SO-SAFE BY DX, Inc., or approved equal.

D. Germicidal Cleaner must be E.P.A. registered germicidal cleaner and deodorizer appropriate for use in public school buildings.

PART 3 – EXECUTION

DEMONSTRATION AND TRAINING

A. Instruction: After Work under this contract is completed, tested, and before acceptance, and not less than 14 days after submittal of the operation and maintenance data required in Paragraph 1.6, Operations and Maintenance Manuals, operate all systems for a period of three 8-hour days during which time keep on the project competent personnel familiar with the items installed whose full-time

assignment will be to instruct the District's maintenance personnel in the operation and maintenance of the equipment and systems.

1. Provide instructors experienced in operation and maintenance procedures.

2. Provide instruction at mutually agreed-upon times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.

3. Schedule training with District, through District's representative, with at least seven days notice.

4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

5. Do not conduct this instruction period before completion of piping and equipment labeling.

B. Provide an instruction period sufficient to cover the training required. This instruction period shall be in addition and subsequent to any period of operation, test and adjustment called for elsewhere in this specification.

C. Program Structure: develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction of the following:

1. System design and operational philosophy.

2. Review of documentation.

3. Operations.

4. Adjustments.

5. Troubleshooting.

6. Maintenance.

7. Repair.

3.2 FINAL AND END-OF-PHASE CLEANING

A. General: Provide final cleaning at the completion of each phase of the work and final project completion. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal, State and local environmental and antipollution regulations. If LBP was disturbed during renovation the final cleaning shall meet the minimum requirements of 40 CFR Part 745.

B. Cleaning: Employ professional cleaning service for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for any phase of Project:

    a. Clean Project site, yard, and grounds in areas disturbed by construction activities including landscape development areas, of rubbish, waste material, letter, and other foreign substances.

    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

    d. Remove tools, construction equipment, machinery, and surplus material from Project site.

    e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

    f. Horizontal surfaces: All horizontal surfaces must be dusted and/or washed until free of dust and grime.

    g. Furnishings and equipment:

        1) Remove all gum and sticky substances from all surfaces. Wash all furniture and equipment with a neutral cleaner. Use specialized cleaner appropriate for wood and/or excessively dirty surfaces.

        2) Dust all machinery and equipment located in any shop area.

        3) Clean all dry-erase boards and marker rails by washing with water and/or dry-erase board cleaner.

        4) Clean exterior of all closed lockers and interior of open ones.

        5) Graffiti must be removed from all furnishings and equipment.

    h. Walls: Wash all wall surfaces with detergent and water. Remove all graffiti. All restroom walls should be washed with a disinfectant cleaner.

    i. Doors: Wash all doors, frames and hardware.

    j. Floors:

        1) Resilient Floors (except linoleum flooring) – Clean and refinish flooring, using appropriate procedures and finishes/sealers. Strip existing wax from all existing resilient flooring (using appropriate safety measures as recommended by the E.P.A. for any tile containing asbestos) and re-wax as follows:

- Classrooms, offices and other rooms - three coats of wax.
- Corridors - five coats of wax.

Newly installed resilient floors should have all surface mastic removed by Design Builder. New floors should be allowed to set for time recommended by manufacturer of mastic. These floors should be scrubbed with detergent -- not stripped. Seal as recommended by flooring manufacturer and re-wax as indicated above.

2) Linoleum Floors - Clean and refinish flooring, using appropriate procedures and finishes/sealers in accordance with manufacturers recommendations and finish as follows:

Newly installed linoleum floors should be allowed to set for time recommended by manufacturer of mastic. Existing and new floors should be scrubbed with a neutral pH (7-8.5) detergent/cleaner – do not strip factory finish. Apply the cleaning solution with a mop and bucket; allow the solution to remain on the floor, and then scrub with a rotary electric scrubber or automatic scrubber with a non-abrasive scrubbing pad. Do not over-saturate the floor. Rinse the entire floor surface with clean, cool water and allow the floor to dry thoroughly before allowing traffic. Apply two (2) coats of “Linobase” sealer, manufactured by Johnson Diversey or as recommended by manufacturer, followed by three (3) coats of “Carefree” finish, manufactured by Johnson Diversey or as recommended by the manufacturer, per manufacturer’s instructions.

3) Concrete Floors - Scrub using water and detergent.

4) Ceramic Floors - Scrub using water and detergent.

5) Carpeted Floors - Vacuum all carpets and clean by hot water extraction.

6) Other Floors - Marble, terrazzo and rubber floors should be cleaned and refinished using appropriate procedures and finishes/sealers.

k. STAIRS: All stairs to be scrubbed with detergent including walls, handrails and ledges. Finish not to be applied to stairs unless necessary and approved by the District (Custodial Services Department).

l. RESTROOMS AND LOCKER ROOMS: Thoroughly clean and disinfect all surfaces and fixtures. Remove all foreign objects from walls/ceilings and eliminate all graffiti. Specifications provided above for fixtures, walls and floors are applicable.

m. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

n. Sweep concrete floors broom clean in unoccupied spaces.

o. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

p. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

q. Remove labels that are not permanent.

r. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over “UL” and similar labels, including mechanical and electrical nameplates.

s. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

t. Replace parts subject to unusual operating conditions.

u. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

v. Clean plumbing fixtures to a sanitary condition, fee of stains, including stains resulting from water exposure.

w. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

x. Clean ducts, blowers, and coils if units were operated without filters during construction.

y. Clean all new and existing light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

z. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Prepare a report.

D. Final Inspection: Any surface still exhibiting dirt, graffiti or dust shall be re-cleaned/re-stripped/refinished until free of dirt, graffiti or dust.

E. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on District’s property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove materials from Project site and dispose of lawfully.

END OF SECTION

1.1 SUMMARY

1.1.1 The Design Builder shall utilize a Building Information Modeling (BIM) system to submit Design Development and Construction Documents in the form of a BIM Model of the Project buildings and Site in a parametric 3D format in order to maximize design and construction coordination of the facility through interference checking (clash detection) and code compliance studies within that electronic format. As is technically feasible, the Design Builder shall also test and modify the proposed construction schedule and the project cost model to optimize the project delivery options for the best overall value and performance by coordinating the BIM Model with the schedule (4D) and using the BIM Model to support cost (5D).

1.1.1.1 The BIM Model and individual system models are the property of the District. The Design Builder shall provide the District with access to the models at any time throughout the project. Submittals are outlined in Section 01 11 20 Design Services and Deliverables.

1.1.1.2 Supplemental BIM requirements for this project are given in the "BIM Standards for the 2118 Milvia Street Project at Berkeley City College" document, which will be included – Reference Documents - portion of the Project Manual by way of future addendum. In the event of a discrepancy between this Section (01 81 00) and the BIM Standards document, this specification takes precedence.

1.1.1.3 Design Builder shall:

1.1.1.3.1 Use the BIM Model and associated model aggregation platform to facilitate the construction methods and means.

1.1.1.3.2 Update the BIM Model and associated model aggregation platform progressively throughout the design and construction period to incorporate all Subcontractor information and approved changes.

1.1.1.3.3 Provide a final "as-built" BIM Model to the District for the District's unrestricted use in operating and managing the facility.

1.1.1.3.4 Engage in regular BIM management meetings with the District and Design Build team participants to discuss and evolve the scope of work described through this section. Discussion topics will include element modeling responsibilities, software interoperability, 2.5d modeling scope, best practices and technical feasibility in the context of rapidly evolving BIM technology.

1.2 USE OF THE BIM/VIRTUAL CONSTRUCTION MODEL

1.2.1 Intent of the BIM Model and Aggregate Platform: The BIM Model and aggregate platform shall be developed for coordination, communication and collaboration purposes during design and construction. At the completion of the Work, the BIM Model shall be turned over to the District. The District shall have exclusive rights to the model for its use in operating and managing the facility.

1.2.2 Basis of Information for Modeling: The Contract Documents and Reference Documents shall be the basis of information for the BIM Model described herein. The Criteria Architect's Architectural Drawings are available in AutoCAD for use by the Design Builder in developing the BIM Model; however, such usage shall be for convenience only and shall not carry contractual implication and subject to DBE executing agreement with Criteria Architect .

1.2.3 Relation of BIM to other Contract Documents: The BIM may be used by the Design Builder as a tool to plan the Work and produce Construction Documents. Hardcopy documentation shall be used as the basis of construction. Not all building components required by the contract documents will be included in the BIM.

1.3 DEFINITIONS

1.3.1 BIM: Building Information Modeling, a process of constructing electronic models of facility's buildings and site.

1.3.2 BIM or Virtual Construction (VC) Model: A Virtual Construction Model using 3-D Building Information Modeling (BIM) technologies to convey the design and construction elements of the Work. The Virtual Model will consist of a minimum of seven system models: Civil, Architectural, Structural, Mechanical, Electrical, Fire Protection and Equipment.

1.3.3 Model Aggregation Platform: The VC system models shall be use Autodesk® Navisworks 2011 software or later.

1.4 MINIMUM REQUIREMENTS

1.4.1 General: The BIM Model shall be developed to include parametric components of major building and site elements as defined by Part 2 of this section.

1.4.2 Accuracy of the Models: The BIM Model and each of its system models shall be developed to within a tolerance of ¼" plus or minus.

1.4.3 Parametric Data: The BIM Model may vary in level of detail for individual elements, but at a minimum shall include sufficient parametric data to support use and analysis of:

1.4.3.1 Functional and visual representation of all spaces.

1.4.3.2 Review of Design Builder's Construction Documents at all times during the Design and Construction phases.

1.4.3.3 Clash detection and correction of all major systems.

1.4.3.4 Construction methods and means.

1.4.3.5 Construction scheduling.

1.4.3.6 Cost estimating.

1.4.3.7 As-built documentation and modeling.

1.4.4 File Format: Revit or any file format (BIM application(s) or software(s)) approved by the District's Project Manager may be used for development of the BIM Model providing that it is a true parametric, data-based application. The District will give preference to a file format that allows direct linking and interoperability. The Design Builder shall maintain a matrix that summarizes BIM software tools used on the project by all participants.

1.4.5 Level of Detail: The BIM Model shall be developed and detailed sufficiently to meet the requirements of the Request for Proposal and the Contract Documents. The two levels of detail are Generic-model(ed) and Project-model(ed), as defined below. All elements listed under Part 2 Products shall be Project-model(ed). All other elements may be Generic-model(ed). The level of detail described by Part 2: Products shall be subject to further discussion, clarification, and evolution through BIM management meetings. The Design Builder will maintain a building component matrix that documents the BIM scope and clarifies responsibilities and level of detail. This matrix shall be subject to District approval.

1.4.5.1 "Generic-model(ed)": the model and its elements may be based upon the standard objects available from the modeling software without project-specific customization. In addition, generic components may be used early in the BIM development process as "placeholders" for "project modeled" components.

1.4.5.2 "Project-model(ed)": the model and/or a specific element must be customized to reflect project-specific configuration.

1.4.5.3 "2.5D Elements": Model management may require use of 2.5D components. This type of component includes parametric, plan and elevation information but does not include 3D data. The scope of use for 2.5D elements shall be determined through discussions held at BIM management meetings.

1.4.6 OmniClass: The OmniClass Construction Classification System (known as OmniClass or OCCS) is a new classification system for the construction industry developed by the Construction Specification Institute (CSI). It builds upon MasterFormat for work results, UniFormat for elements and EPCI (Electronic Product Information Cooperation) for structuring products. OmniClass is a

reference library that will serve as the foundation upon which information is transferred between the construction and operations phases via the BIM Model. The Design Builder shall include the appropriate OmniClass classification in the list of attributes that is assigned to the building elements that will be Project-model(ed).

PART 2 - PRODUCTS

2.1 SYSTEM MODELS

2.1.1 Civil Systems: The Civil Systems Model shall be a sub-system model linked to the architectural system model. The Civil Systems model shall serve as the basis for project shared coordinates through which the position of building elements on the site will be coordinated. Except as noted, provide project-model(ed) elements of:

2.1.1.1 Topography: 1) existing natural and/or graded contours, and 2) new grades and finish contours.

2.1.1.2 Planting: 1) existing major landscaped areas, 2) existing trees to remain, 3) new landscaped areas, 4) new trees, and 5) irrigation lines over 2” diameter. Planting may be generic-model(ed).

2.1.1.3 Surface Improvements: 1) pavements, 2) curbs and gutters, 3) retaining walls, and 4) exterior non-building structures such as pools, shade structures etc.

2.1.1.4 Existing Structures: 1) all buildings within the project area intended to remain, 2) buildings intended to be demolished. All existing structures may be generic-model(ed) exterior surface only; interior elements are not required.

2.1.1.5 Storm Water and Sanitary Sewers: 1) existing lines (over 3” diameter), boxes and structures within project area, 2) all new lines, boxes and structures, and 3) existing public lines, boxes and structures beyond the project area but serving as points of connection for the project. Storm Water and Sanitary Sewers outside the buildings may be generic-model(ed).

2.1.1.6 Utilities: 1) existing domestic and fire water main and branch lines (2” and larger diameter) within project area, 2) all new domestic and fire water lines, 3) existing electrical overhead and underground lines within project area, all new electrical lines outside buildings, 4) existing telephone and data lines within project area, 5) all new telephone and data lines outside buildings, 6) existing gas lines within project area, and 7) all new gas lines outside buildings. Utilities outside buildings may be generic-model(ed).

2.1.1.7 Other requirements:

2.1.1.7.1 Quantities: data to reflect accurate quantities of the above elements.

2.1.1.7.2 Schedules: data for installation of the above elements.

2.1.2 Architectural Systems: The Architectural Systems Model shall be the primary model to which others are linked. Except as noted, provide project-model(ed) elements of:

2.1.2.1 Spaces: 1) net square footage of all occupied spaces, 2) gross constructed floor area, 3) room names and numbers, and 4) floor, base, wall, and ceiling finishes.

2.1.2.2 Exterior Walls and Curtain Walls: 1) type and composition, 2) height, length, and width, and 3) thermal, acoustic, fire, and security ratings.

2.1.2.3 Partitions: 1) type and composition, 2) height, length, and width, and 3) thermal, acoustic, fire, and security ratings.

2.1.2.4 Floors: 1) type and material, 2) thickness, and 3) finishes with manufacturer's name and product numbers. Link floor structure to the Structural Systems Model.

2.1.2.5 Ceilings: 1) type and composition, 2) height, length, and width, and 3) thermal, acoustic, fire, and security ratings.

2.1.2.6 Roof Coverings and Openings: 1) configuration, 2) drainage system, and 3) penetrations for modeled building components.

2.1.2.7 Exterior Doors, Windows, and Louvers: 1) type and material, 2) height, width, and thickness, 3) thermal, acoustic, fire, and security rating, 4) location, and 5) hardware elements or group.

2.1.2.8 Interior Doors, Windows, and Louvers: 1) type and material, 2) height, width, and thickness, 3) thermal, acoustic, fire, and security rating, 4) location, and 5) hardware elements or group.

2.1.2.9 Stairs and Ramps: 1) stairs and railings, 2) ramps and railings, and 3) handrails and guardrails.

2.1.2.10 Elevators and Escalators: 1) elevator cabs and doors, 2) elevator hoist-way doors and trim, 3) elevator machinery and equipment, 4) escalator belts and railings, and 5) escalator machinery and equipment.

2.1.2.11 Casework and Counters: 1) type and material, 2) height, width, and depth, 3) location, and 4) hardware.

2.1.2.12 Plumbing Fixtures: 1) type and material, 2) location, 3) trim, and 4) finishes. Link fixtures and trim to the Mechanical Systems Model.

2.1.2.13 HVAC Grills and Registers: 1) type and material, 2) location, 3) trim, and 4) finishes. Link fixtures and trim to the Mechanical Systems Model.

2.1.2.14 Electrical Fixtures: 1) type and material, 2) bulb type and wattage, 3) location, 4) trim, and 5) finishes. Link fixtures and trim to the Electrical Systems Model.

2.1.2.15 Miscellaneous Fittings: 1) toilet partitions, 2) toilet room accessories, 3) grab bars, 4) personal storage lockers, 5) display cases, and 6) other surface applied quasi-permanent items such as mirrors etc.

2.1.2.16 Other requirements:

2.1.2.16.1 Quantities: data to reflect accurate quantities of the above elements.

2.1.2.16.2 Schedules: data for installation of the above elements.

2.1.3 Structural Systems: The Structural Systems Model shall be a sub-system model linked to the architectural system model. Except as noted provide project-model(ed) elements of:

2.1.3.1 Foundations and footings: 1) type and configuration, and 2) depth, length, and width.

2.1.3.2 Slab(s) on-grade: 1) type and configuration, 2) under-slab base and waterproofing, 3) recesses, curbs, pads, closure pours, and 4) major penetrations.

2.1.3.3 Basement Walls: 1) type and composition, 2) height, length, and width, and 3) thermal, acoustic, fire, and security ratings.

2.1.3.4 Elevated Floors: 1) columns and beams, 2) primary and secondary framing members, 3) bracing, 4) connections, and 5) framed, composite, and/or slab decks.

2.1.3.5 Roofs: 1) columns and beams, 2) primary and secondary framing members, 3) bracing, 4) connections, and 5) framed, composite, and/or slab decks.

2.1.3.6 Joints: 1) expansion and/or contraction, and 2) seismic.

2.1.3.7 Stairs and Ramps: 1) openings and framing, and 2) railing supports.

2.1.3.8 Shafts and Pits: 1) openings and framing, and 2) railing supports.

2.1.3.9 Other requirements:

2.1.3.9.1 Quantities: include data to reflect accurate quantities of the above elements.

2.1.3.9.2 Schedules: data for installation of the above elements.

2.1.3.9.3 Fireproofing: Fireproofing is not to be included in the BIM but clash detection studies shall include definition of tolerances for conflict detection.

2.1.3.9.4 Color Code: color code structural steel from other elements.

2.1.4 Mechanical: The Mechanical Systems Model shall be a sub-system model linked to the architectural system model. Except as noted provide project-model(ed) elements of:

2.1.4.1 Heating, Ventilating, and Air Conditioning: 1) all heating, ventilating, air-conditioning, exhaust fans, and specialty equipment, 2) air supply, return, ventilation and exhaust ducts, including space-consuming elbows and transitions, 3) fire dampers with ratings, 4) mechanical piping, and 5) registers, diffusers, grills and hydronic baseboards. Coordinate and link fixtures and trim to the Architectural Systems Model.

2.1.4.2 Plumbing: 1) all domestic plumbing piping and fixtures, 2) floor and area drains, and 3) related equipment.

2.1.4.2.1 Piping larger than 1 .5" diameter shall be modeled.

2.1.4.3 Roof Drainage: 1) all piping and fixtures, and 2) related equipment.

2.1.4.3.1 Piping larger than 1 .5" diameter shall be modeled.

2.1.4.4 Other requirements:

2.1.4.4.1 Quantities: data to reflect accurate quantities of the above elements.

2.1.4.4.2 Schedules: schedule data for installation of the above elements.

2.1.4.4.3 Equipment Clearances: Clearances for major equipment and all M/E/P Equipment and Architecturally Significant Equipment, as model objects for conflict detection and maintenance access requirements.

2.1.4.4.4 Color Code: separate color code for each type element.

2.1.5 Electrical: The Electrical Systems Model shall be a sub-system model linked to the architectural system model. Except as noted provide project-model(ed) elements of:

2.1.5.1 Interior Electrical Power and Lighting: 1) all interior electrical components, 2) lighting, receptacles, special and general purpose

power receptacles, 3) lighting fixtures, 4) panel-boards and control systems, and 5) conduit and cable trays.

2.1.5.1.1 Individual conduit larger than 1 .5" diameter shall be modeled.

2.1.5.1.2 Groups or clusters runs of conduit of all sizes shall be modeled.

2.1.5.2 Exterior Building Lighting: 1) all exterior electrical components, 2) lighting, receptacles, special and general purpose power receptacles, 3) lighting fixtures, 4) panel-boards and control systems, and transformers, and 5) utility connection and equipment.

2.1.5.2.1 Individual conduit larger than 1 .5" diameter shall be modeled.

2.1.5.2.2 Grouped or clustered runs of conduit of all sizes shall be modeled.

2.1.5.3 Telephone, Data, Television, and Other Low Voltage: 1) all interior low voltage components, 2) outlets, receptacles, special and controls, 3) fixtures, 4) panel-boards, equipment racks, and control systems, and 5) conduit and cable trays.

2.1.5.3.1 Individual conduit larger than 1 .5" diameter shall be modeled.

2.1.5.3.2 Groups or clusters runs of conduit of all sizes shall be modeled.

2.1.5.4 Other requirements:

2.1.5.4.1 Quantities: data to reflect accurate quantities of the above elements.

2.1.5.4.2 Schedules: schedule data for installation of the above elements.

2.1.5.4.3 Equipment Clearances: Clearances for major as model objects for conflict detection and maintenance access requirements.

2.1.5.4.4 Color Code: separate color code for each type element.

2.1.6 Fire Suppression: The Fire Suppression Systems Model shall be a sub-system model linked to the architectural system model. Except as noted provide Project-model(ed) elements of:

2.1.6.1 Fire Suppression System: 1) valves and risers, 2) all main, branch, and drains lines, 3) sprinkler heads, and fittings, 4) pumps.

2.1.6.2 Fire Alarms: 1) alarm and notification devices, and 2) detection systems.

2.1.6.3 Other requirements:

2.1.6.3.1 Quantities: data to reflect accurate quantities of the above elements.

2.1.6.3.2 Schedules: schedule data for installation of the above elements.

2.1.6.3.3 Equipment Clearances: Clearances for major equipment as model objects for conflict detection and maintenance access requirements.

2.1.6.3.4 Color Code: separate color code for each type element.

2.1.7 Equipment: The Equipment Model shall be a sub-system model linked to the architectural model. Except as noted provide Project-model(ed) elements of:

2.1.7.1 Equipment: related security, mechanical, plumbing, and electrical requirements.

2.1.7.1.1 Quantities: data to reflect accurate quantities of the above elements.

2.1.7.1.2 Schedules: schedule data for installation of the above elements.

2.1.7.1.3 Equipment Clearances: equipment clearances as model objects for conflict detection and maintenance access requirements.

2.2 MODEL SOFTWARE REQUIREMENTS

2.2.1 The Design Builder's selected BIM application(s) and software(s) for the BIM Model shall:

2.2.1.1 Have maximum interoperability between systems models, and shall be fully compatible with Autodesk® Navisworks 2011 software and later.

2.2.1.2 Be provided in a format that is compatible with a free software download for viewing the Design Builder’s models with the ability to save and track user annotations and notes.

2.2.1.3 Contain reports/logs of:

2.2.1.3.1 Discrepancies and/or clarifications in the Contract Documents or Construction Documents identified during the modeling process.

2.2.1.3.2 Conflicts between location and alignment of model elements with resolutions developed by the Design Builder.

2.2.1.3.3 Quantities of modeled building element.

2.2.1.3.4 Schedule for each building element.

2.2.1.4 For any additional electronic model information that is not supported by the Revit or the primary software solution approved by Program Manager, and for constructing 4D models, the Design Builder shall utilize AutoDesk® Navisworks software (Manage, Review, Simulate and Freedom) to create and utilize .nwd files.

2.2.1.5 Be provided in a format that links with cost and scheduling software utilities.

PART 3 - EXECUTION

3.1 DEVELOPMENT AND SUBMITTAL OF THE MODELS

3.1.1 The Design Builder shall develop the BIM Model and its systems models in compliance with the Contract Documents and the following:

3.1.1.1 Develop and submit all of the systems models concurrently. Note: if any of the systems models qualify as deferred approvals, they may be submitted separately.

3.1.1.2 Submit models with generic-model(ed) information as required to satisfy the requirements of the Request for Proposal.

3.1.1.3 Submit partially completed models during the Design Development and Construction Documents Phase submittals outlined in Section 01 11 20 (Design Services and Submittals), for review and coordination.

3.1.1.4 Submit partially complete models at any time when the District requests changes and/or clarifications or Design Builder proposes changes.

3.1.1.5 Submit fully completed BIM Model and its systems models, prior to construction.

3.1.1.6 Submit updated systems models complying with final approved shop drawing submittals.

3.1.1.7 Submit the “as-built” BIM Model and its systems models as part of the close-out process.

3.2 UPDATING THE MODELS DURING CONSTRUCTION

3.2.1 The BIM Model shall be updated/revised to keep it current with construction activity as follows:

3.2.1.1 Updating: issue the BIM Model and its systems models one week before each regularly scheduled Construction Phase Coordination meeting as defined in Section 01 31 19 (Project Meetings).

3.2.1.2 Revising: issue the revised BIM Model and/or its systems models immediately after each meeting or other activity where revisions have been made. Include a report that indicates every change.

3.2.2 Submit the updates and revisions to the District.

3.3 DELIVERY OF FINAL AS-BUILT MODELS

3.3.1 The final updated and revised BIM Model and all its systems models shall be submitted to the District as part of the close-out submittals.

3.3.2 The BIM Model and all its systems models will be:

3.3.2.1 Editable for future expansion or remodel projects.

3.3.2.2 Functioning for use with 3-D Facilities Management Software.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes general requirements and procedures for achieving Project goal of United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED™) Silver-level certification. The team is Considering pursuing LEED Gold. Additional requirements for LEED Gold have been noted.

1. Rating System: LEED v4.1 for Building Design and Construction.

2. Product submissions and contracting procedures will be evaluated based upon credits required to achieve specified level of certification. Contributions to achieve a higher level of certification are encouraged.

3. A copy of the LEED Project Checklist is attached at end of this Section for reference.

4. Some LEED prerequisites and credits are required to obtain the LEED certification indicated depend on the Architect's design and are not part of the Contractor's Work. Contractor's responsibilities are specified in this section and throughout the technical specification sections.

B. Related Sections:

1.. Specific material requirements identified as "Sustainable Design Requirements" located in other Sections, which may refer to criteria in this Section.

1.2 REFERENCES

A. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

1. ASHRAE 52.2-2017 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

2. ASHRAE 90.1-2016 Energy Standard

3. ASHRAE 62.1-2016 Min Standards for Indoor Air Quality Sections 4, 5, 6.2, 6.5 and 7

4. ASHRAE 55-2017 Thermal comfort conditions for Human Occupancy

B. Sheet Metal and Air Conditioning Society of North America (SMACNA):

1. IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition, 2007, ANSI/SMACNA 008-2008, Chapter 3.

C. United States Green Building Council (USGBC):

1. LEED v4.1 Building Design and Construction (BD+C) Guide.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Designate a Representative that is LEED Accredited by the USGBC. Contractor's LEED Representative shall oversee the environmental goals for the project, coordinate with the Architect, shall instruct workers concerning these goals, and shall be present on site when Work is in progress.

B. For LEED prerequisites and credits that are Contractor's responsibility, submit documentation to USGBC using online USGBC online platform. Assist Architect and/or owner with responses to questions and requests from USGBC that depend on product selection or product qualities, or that depend on Contractor's procedures, until USGBC has made its determination on Project's LEED certification application.

1.4 SUBSTITUTIONS

A. Comply with substitution criteria identified in Division 1 - "Product Requirements".

B. To substitute products that affect LEED certification, propose products that offer equivalent or increased environmental sensitivity and meet the intent of the Contract Documents. Substitutions that may affect LEED certification, products or criteria shall be clearly identified as defined in technical specification.

1.5 SUBMITTALS

A. Subcontractor Responsibility Matrix: Contractor shall prepare and submit for review a responsibility matrix identifying which subcontractors are responsible for providing specific information to the Contractor for LEED documentation.

1. Contractor is responsible for preparing and tracking all LEED strategies agreed to by the subcontractors and for gathering all information required to document and submit to USGBC for LEED certification.

B. Total Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Apply these values consistently to various Sustainability submittals requiring calculations based upon material cost data.

1. Include breakout of costs for the following categories of items:

a. Fire Suppression (Division 21).

b. Plumbing (Division 22).

c. Mechanical/HVAC (Division 23).

d. Electrical (Division 26).

e. Communications (Division 27).

f. Electronic Safety and Security (Division 28).

g. Specialty items such as Conveying Equipment (Section 14 21 50) and equipment (Exclude mechanical, plumbing and electrical equipment).

h. Wood-based construction materials (Section 06 10 53 and 06 41 00).

2. Provide the following with final project submittals:

    a. Final Summary of Solid Waste Disposal and Diversion (Section 01 74 19)

    b. All approved Substitution Request Forms related to this section.

C. Sustainable Design Action Plans: Within 30 days of Contract Award, submit Action Plans indicating how LEED credits related to the following will be met:

1. MR Credit - Construction and Demolition Waste Management Plan complying with Section 01 74 19 “Construction Waste Management and Disposal”.

2. EQ Credit - Construction Indoor Air Quality Management Plan and Indoor Air Quality Assessment Plan.

D. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with Sustainable Design Action plans for the following:

1. MR Credit – Construction and Demolition Waste Management: Waste reduction progress reports complying with Section 01 74 19 “Construction Waste Management and Disposal”.

2. MR Credit – Sourcing of Raw Materials: Recycled content. (LEED Gold only)

3. MR Credit – Sourcing of Raw Materials: Regionally manufactured materials. (LEED Gold only)

4. MR Credit – Sourcing of Raw Materials: Certified wood products. (LEED Gold only)

5. EQ Credit – Construction Indoor Air Quality Management Plan: Construction Indoor Air Quality (IAQ) Management plan: During Construction.

6. EQ Credit – Indoor Air Quality Assessment: Indoor Air Quality (IAQ) Assessment plan: Before Occupancy or Aire Testing.

E. Sustainable Design Documentation Submittals: Additional Sustainable Design submittal requirements are identified in other Sections. Submit documentation for LEED prerequisites and credits in the format required by the USGBC“LEED BD+C Guide” . Contractor shall include Sustainable Design data simultaneously with other submittals required. This data may include the following:

1. Documentation complying with Section 01 74 19 Construction Waste Management and Disposal.

2. Total Project Materials Cost Data.

3. Environmental Product Declarations (EPD’s) complying with LEED requirements. (LEED Gold only)

4. Documentation for products that comply with LEED requirements for multi-attribute optimization. (LEED Gold only)

5. Sustainability reports for products that comply with LEED requirements for sourcing of raw materials.

6. Material ingredient reports for products that comply with LEED requirements for material ingredient reporting. (LEED Gold only)

7. Documentation for products that comply with LEED requirements for material ingredient optimization. (LEED Gold only)

8. Product data for adhesives and sealants used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.

9. Product data for paints and coatings used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.

10. Laboratory test reports for flooring, indicating compliance with requirements for low-emitting materials. (LEED Gold only)

12. Laboratory test reports for ceilings, indicating compliance with requirements for low-emitting materials.

14. Laboratory test reports for furniture, indicating compliance with requirements for low-emitting materials.

15. Laboratory test reports for products containing composite wood or agrifiber products or wood glues, indicating compliance with requirements for low-emitting materials. (LEED Gold only)

16. Requirements of Plumbing submittal packages.

17. Requirements of Mechanical submittal packages.

18. Construction Indoor Air Quality (IAQ) Management:

    a. Construction IAQ management plan.

    b. Product data for temporary filtration media.

    c. Product data for filtration media used during occupancy.

    d. Construction Documentation: Six photographs at three different times during construction period, along with a brief description of SMACNA approach employed, documenting implementation of IAQ management measures, including protection of ducts and on-site stored or installed absorptive materials.

1.6 QUALITY CONTROL

A. LEED Certification Meetings: Schedule and conduct LEED Certification meetings on a regular basis, but not less than quarterly, or as agreed between the Contractor's LEED Representative and the Architect. Meeting attendees shall include at least the following: Owner's Representative, Architect, Contractor's Project Manager, Contractor's LEED Representative, and Sub-Contractor Representatives as appropriate to stage of Work. Discuss LEED Certification at preconstruction and regular job site meetings. Discuss LEED Certification goals and challenges at the following meetings:

B. Provide environmental training for workers performing Work on the Project site. Training shall include the relevant requirements for this project.

C. Regulatory Requirements: Comply with applicable requirements of laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from authorities having jurisdiction.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Provide products and procedures necessary to obtain LEED credits indicated as Contractor's responsibility. Although other Sections may specify some requirements that contribute to these LEED credits, Contractor provides additional materials and procedures necessary to obtain LEED credits indicated.

2.2 LOW-EMITTING MATERIALS

A. Comply with specified emissions criteria of individual material specifications. In certain cases, this emissions criteria for materials located inside of the waterproofing membrane may be waived if the following standards are met:

1. Paints and Coatings: 75 percent of paints and coatings must meet the CDPH V1.2-2017 VOC emissions evaluation and 100 percent must meet the VOC content requirements per SCAQMD 1113.

2. Adhesives and Sealants: Meet CALGreen requirements for adhesives and sealants.

3. Flooring: A minimum of 90 percent of flooring products must meet the VOC emissions evaluation or inherently non-emitting sources criteria or salvaged and reused materials criteria. Subflooring is excluded. (LEED Gold only)

4. Ceilings: A minimum of 90 percent of ceilings must meet the VOC emissions evaluation or inherently non-emitting sources criteria or salvaged and reused materials criteria. Ceiling products include ceiling panels, ceiling tile, surface ceiling structures, suspended systems, and glazed skylights. Overhead structural elements are excluded.

6. Composite Wood: Meet CARB Phase II per CALGreen

7. Furniture (when submitted by Contractor): A minimum of 75 percent of furniture must meet the furniture emissions evaluation or inherently non-emitting sources or salvaged and reused materials criteria. All standalone furniture is included.

PART 3 – EXECUTION

3.1 GENERAL

A. The contractor is responsible for ensuring proper field execution of all LEED prerequisites, credits, and submittal requirements; communication with sub-contractors of all requirements; and submission of all documentation in a timely manner.

B. Contractor shall notify Owner immediately of failure to meet any stated LEED pre-requisite or credit requirement.

C. Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

3.2 CONSTRUCTION WASTE MANAGEMENT

A. Comply with Section 01 74 19 “Construction Waste Management and Disposal” to meet identified MR credit.

3.3 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT

A. Comply with SMACNA “IAQ Guideline for Occupied Buildings under Construction" to meet identified EQ credit.

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 1, install MERV 8 filter media in accordance with ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.

2. Replace air filters immediately prior to occupancy with new filters specified in Division 23.

3.4 INDOOR AIR QUALITY (IAQ) ASSESSMENT

A. Comply with USGBC “Guide” to meet identified EQ credit.

1. For the purpose of this requirement, “interior finishes” shall include millwork, doors, paint, carpet and acoustical tiles. The presence of nonfixed furnishings such as workstations and partitions is not required but is encouraged.

B. Option 1 - Provide one of the following building flush-out methodologies:

1. Construction complete; interior finishes installed; building unoccupied throughout flush-out: Perform building flush-out by supplying a total volume of 14,000 cubic feet of outdoor air per square foot of floor area while maintaining an internal temperature of at least 60 degrees F and a relative humidity no higher than 60 percent.

2. Construction complete; interior finishes installed; building occupied prior to flush-out completion: The space may be occupied following delivery to the space of a minimum of 3500 cubic feet of outdoor air per square foot of floor area. Once a space is occupied, it is ventilated at a minimum rate of 0.30 cfm per square foot of outside air or the design minimum outside-air rate prerequisite, whichever is greater. During each day of the flush-out period, ventilation begins a minimum of three hours prior to occupancy and continues during occupancy. These conditions are maintained until a total of 14,000 cubic feet per square foot of outside air has been delivered to the space.

B. Option 2 - Provide Air Quality Testing:

1. Construction complete; interior finishes installed; ventilation conditions typical for occupancy; prior to occupancy: Conduct baseline IAQ testing in occupied spaces for particulate matter, inorganic gases and volatile organic compounds in accordance with LEED BD+C Guide.

2. Demonstrate that contaminant maximum concentrations listed below are not exceeded:

    a. Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

    b. Particulates (PM10): 50 mcg/cu. m.

    c. Particulates (PM2.5): 12 mcg/cu. m.

    d. Ozone: 0.07 ppm, in accordance with ASTM D5149.

    e. Formaldehyde: 20 mcg/cu. m.

    f. Acetaldehyde: 140 mcg/cu. m.

    g. Benzene: 3 mcg/cu. m.

    h. Hexane: 7000 mcg/cu. m.

    i. Naphthalene: 9 mcg/cu. m.

    j. Phenol: 200 mcg/cu. m.

    k. Styrene: 900 mcg/cu. m.

    l. Tetrachloroethylene: 35 mcg/cu. m.

    m. Toluene: 300 mcg/cu. m.

    n. Vinyl Acetate: 200 mcg/cu. m.

    o. Dichlorobenzene: 800 mcg/cu. m.

    p. Xylenes - Total: 700 mcg/cu. m.

3. For each sampling point where the maximum concentration limits are exceeded, take corrective action until requirements have been met.

4. Air sample testing to be conducted as follows:

    a. All measurements to be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside-airflow rate for the occupied mode throughout the duration of the air testing.

    b. Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points to not be less than one per 5000 square feet. For large open spaces, one sampling point per 50,000 square feet may be used.

    c. Air samples to be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

3.5 PROTECTION

A. Protect stored on-site and installed absorptive materials from moisture damage. Where absorptive materials not intended for wet applications are exposed to moisture, immediately remove from site and dispose of properly.

B. Protect installed materials using methods that do not support growth of molds and mildews.

1. Immediately remove from site and properly dispose of materials showing signs of mold and signs of mildew, including materials with moisture stains.

END OF SECTION

1.1 SUMMARY

1.1.1 Scope of Work: The Design Builder shall hire a competent Hazardous Materials Consultant to investigate, survey and report on Hazardous Materials discovered at the site. Except as otherwise expressly specified herein, the Design Builder's Hazardous Substances Removal Contractor ("Contractor") will supply all labor, supervision, materials, equipment, tools, services, insurance and each and every item of expense necessary for the removal, handling, management, packaging, transportation and disposal of miscellaneous hazardous materials, herein called the "Work."

1.1.2 Applicability: Except as otherwise may be provided for, the requirements of the Contractor will apply to the Design Builder and, by extension, to all subcontractors engaged in the removal or handling of the miscellaneous hazardous materials designated herein. To the extent allowable by law, the District will be the sole and final arbiter of which contractor(s) or subcontractor(s) qualify to remove Hazardous Materials at the Project Site.

1.1.3 Miscellaneous Hazardous Materials: The Contractor shall notify the District of the presence of any items identified in specification 4.11 of Section 00 50 00 (Form of Agreement) within 24 hours of its discovery at the Project site.

1.1.4 Limitation of Responsibility: The role of the Design Builder's Industrial Hygiene Consultant (hereinafter referred to as the "Project IH Consultant") in this project is to provide independent, third-party industrial hygiene/hazardous materials consulting services on behalf of the District. Such services may or may not include conducting on-site work observations, materials or environmental testing, and/or consulting with the District. It is not the responsibility of the Project IH Consultant to supervise the Contractor; nor to direct the Contractor's work effort; nor to assume the management of, or responsibility for, the Contractor's health and/or safety practices, nor its waste management, nor its regulatory compliance. At all times, the Contractor is solely responsible for the quality and execution of all phases and aspects of the Work.

1.2 SUBMITTALS

1.2.1 General:

1.2.1.1 In addition to any other contractual submittals required of the Contractor, the Contractor will provide the submittals described in this Section. Submittals will be reviewed by both the District and the Project IH Consultant for acceptability. The Project IH Consultant will either recommend submittals to the District for acceptance, or will return them as deficient, with notations for correction and re-submission. The Project IH Consultant does not have authority to "approve" submittals.

1.2.2 Schedule And Format:

1.2.2.1 Delivery: Submittals listed in this section must be delivered to the District for conveyance to the Project IH Consultant.

1.2.2.2 Quantity: Five (5) identical, legible copies and one complete pdf of each submittal listed in this section shall be delivered in an organized fashion suitable to the District for review. One (1) copy will be conveyed by the District to the Project IH Consultant for review.

1.2.2.3 Work Commencement: No portion of the Work that is dependent upon submittal acceptance shall be commenced by the Contractor until the submittals are reviewed and accepted by the District or its designated representative.

1.2.2.4 Delays: Delays to the Work resulting from the submittal of deficient or illegible documentation, or from the untimely submittal of potentially acceptable documentation, shall be the sole responsibility of the Design-Builder. Except as otherwise granted by the District, no extensions will be made to the awarded contract schedule or budget to accommodate such delays.

1.2.2.5 Format: Submittals will be provided in 8-1/2" x 11" format, organized in a standard 3-ring binder, with sections separated by numbered tabs indexed to a printed Table of Contents. Illegible submittals will be considered deficient and returned to the Design/Builder for correction.

1.2.2.6 Pre-work Submittals: Pre-work submittals shall be delivered to the District not less than ten (10) Business Days prior to the Contractor's mobilization onto the work site. Deficient submittals must be resubmitted by the Design-Builder within five (5) Business Days after return of review copy. Once accepted, the reviewed copy will be returned to the Design-Builder, who must maintain a copy of the reviewed submittal at the job site. The following is to be submitted:

1.2.2.6.1 Worker Qualifications: Name and qualifications of each employee to be engaged in handling or removal of materials specified in this Section.

1.2.2.6.2 Technician Certification: The U.S. EPA requires that individuals who perform maintenance, service, repair, or disposal of ODCs be certified in accordance with Section 608 of the Clean Air Act, as amended (Section 608). The Contractor will submit documentation of certification for any technician or subcontractor to be in engaged in work covered by Section 608.

1.2.2.6.3 Worker Training: The Contractor shall provide current (within previous 12 months) valid documentation of worker training in accordance with Cal/OSHA Hazardous Waste

Operations and Emergency Response (8 CCR §5192, "HAZWOPER") for any workers or subcontractors engaged in work specified in this Section. An exception to this training requirement will be made for workers or subcontractors engaged solely in work involving handling or disposal of ODCs.

1.2.2.6.4 Permits/Licenses: The Design-Builder is responsible for obtaining any permits or licenses and for making any regulatory notifications required to perform the work of this Section. The Design-Builder will deliver one (1) copy of all permits, approvals and notifications to the District at least five (5) Business Days before beginning the Work of this Section.

1.2.2.6.5 Subcontractors: Submit qualifications and twenty-four (24) hour contact information for each subcontractor to be used. This shall include two (2) legible copies of federal, state, and/or local business or operating permits, as well as State and/or EPA identification numbers for the waste transporters and disposal facilities to be used.

1.2.2.6.6 Waste Hauling Qualifications: Submit proof of hazardous waste transporter's registration and the vehicle operator training. Submittals shall include, but not necessarily be limited to: business name, address (mailing address and physical location), and business telephone number of the company; primary contact name and emergency contact (24-hour) telephone number; documentation of current State and/or EPA authorization to operate; and insurance coverage.

1.2.2.6.7 Waste Disposal Facility Qualifications: Submit documentation of the California State and/or EPA-approved waste recycling, disposal, and/or treatment facilities designated to receive shipments of hazardous and universal wastes generated during this project. Such information will include, but not necessarily be limited to: business name, address (mailing address and physical location), and business telephone number of the facility; primary contact name and emergency contact (24-hour) telephone number; documentation of current State and/or EPA authorization to operate; operator's facility I. D. number; classification and/or types of waste(s) accepted; name, business address and telephone number of insurance provider; documentation of insurance type(s), coverage amounts, and any limitations on liability; and any regulatory agency information pertaining to known citations issued, notices of violations issued, corrective actions

ordered, Records of Decisions rendered, or on-going environmental investigations or known liabilities.

1.2.2.7 Post-work Submittals: The Design-Builder will, within twenty (20) Business Days of Contractor's demobilization from the Project Site, submit two (2) copies of all waste disposal documentation (waste manifests, recycler's or reclaimer's receipts, or other applicable documentation) to demonstrate appropriate material management and disposal. If the Project IH Consultant or District determines that the Post-work Submittals are inadequate and/or require additional unanticipated review time, the Contractor will be required to correct the deficiencies and re-submit them for additional review. Any additional cost for the Project IH Consultant's time to perform a subsequent review(s) of Post-work Submittals will be borne by the Design-Builder.

1.3 QUALITY REQUIREMENTS

1.3.1 Reference Standards:

1.3.1.1 Regulations: Applicable regulations pertaining to this work include, but are not limited to, the following:

1.3.1.1.1 California Department of Occupational Safety and Health (Cal-OSHA) – General Industry Safety Orders Hazardous Waste Operations and Emergency Response (8 CCR §5192 et seq.).

1.3.1.1.2 California Health & Safety Code Section 25163(c).

1.3.1.1.3 Title 22, California Code of Regulations, Section 66261.24 et seq.

1.3.1.1.4 Title 22, California Code of Regulations, Section 66268.7(a)(4) et seq.

1.3.1.1.5 Title 22, California Code of Regulations, Section 66268.114 et seq.

1.3.1.1.6 California Safe Drinking Water and Toxic Enforcement Act of 1986 (Prop. 65).

1.3.1.1.7 Title 22, California Code of Regulations, Division 4.5, Chapter 23 – Universal Waste Rule - California Department of Toxic Substances Control (DTSC).

1.3.1.1.8 Title 40, Code of Federal Regulations, Part 61, Subpart M, National Emission Standards for Hazardous Air Pollutants (NESHAP) (U.S. EPA).

1.3.1.1.9 Title 40, Code of Federal Regulations, Part 82 et seq., Protection of Stratospheric Ozone. U.S. Environmental Protection Agency (U.S. EPA).

1.3.1.1.10 Title 40, Code of Federal Regulations, Part 761, et seq., Polychlorinated Biphenyl (PCBs) Manufacturing, Processing, Distribution in Commerce and Use Prohibitions. U.S. Environmental Protection Agency (U.S. EPA).

1.3.1.1.11 Title 49, Code of Federal Regulations, Part 172, U.S. Department of Transportation.

1.3.1.1.12 All other applicable Federal, State, and/or Local regulations, codes, and ordinances.

1.3.1.2 Applicability. The most current version of each document shall apply. Where conflicts among these specifications exist, the more strict or stringent requirement or interpretation shall apply.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1 Examination of Conditions: The Design/Builder must carefully examine the work site before beginning work and report any previously undisclosed or special conditions to the District. Except as may be otherwise stipulated elsewhere in the Contract Documents, starting the Work shall be interpreted as implied acceptance of conditions as they exist.

3.1.2 Responsibility for Work: By commencing the Work, Design/Builder acknowledges and agrees that it has sole and primary responsibility and obligation to the District to make inspections of its own work at all stages of the Work. This includes acknowledging and agreeing that it has sole responsibility to supervise or superintend the performance of the Work, and that said work will be in strict adherence to, and in compliance with, all applicable methods, materials, regulations, and required standards whether or not specified herein. Where conflicts arise between standards or regulations, the more stringent will apply.

3.1.3 Coordination of Work: The Design-Builder is responsible to coordinate all scheduling, phasing, and completion of the Work with the District and all other employers working on the job site.

3.1.4 Measurements and Quantities: The Design-Builder is responsible to field verify all measurements, dimensions and quantities before starting the Work. Discrepancies between plan and field dimensions or quantities must be reported to the District as soon as discovered.

3.2 WASTE MANAGEMENT AND DISPOSAL

3.2.1 General: The Design-Builder is responsible for the safe handling, storage and transportation of all hazardous waste generated by the Work. By commencing this work, the Design-Builder implicitly agrees to bear all costs arising from any claims, damages, losses, and/or clean-up expenses incurred which, as a result of the Design-Builder's negligence, result from a hazardous waste spill(s) or release(s) on the Project site and/or while hazardous waste is in transport to a waste disposal facility. The Design-Builder or its designated subcontractor waste hauler will deliver all waste materials to an appropriately designated waste disposal facility that is acceptable to the District and which is permitted in accordance with applicable regulations.

3.2.2 Storage Facilities: The Design-Builder will assure that all waste (hazardous and non-hazardous) generated by the Work is stored in a secured manner until received at the waste disposal facility. Debris bins, storage enclosures, etc. will be locked overnight and whenever the Design-Builder is off-site or unable to directly monitor the contents. The Design-Builder will ensure that the appropriate and required warning signs are posted on waste storage locations. The Design-Builder will be responsible to maintain the waste storage facilities in an orderly and well-kept condition at all times. The Design-Builder will conduct routine waste storage area inspections to assure that appropriate storage conditions are maintained. Waste is not to be co-mingled with stored non-waste material or equipment.

3.2.3 Off-site Shipment of Wastes: The Design-Builder shall notify the District or its Representative in advance, whenever hazardous waste must be removed from the site. A copy of the Uniform Hazardous Waste Manifest or any other documents required by Federal, State, or Local agencies shall be completed by the Design-Builder and submitted to the District or its Representative for review and signature prior to transporting hazardous waste materials to a disposal facility. The Design-Builder shall provide the District or its Representative with sufficient advance notice of the need to obtain manifest signatures, so as to not delay waste shipment or otherwise impede the Project Schedule. Only the District or its Representative has authority to sign or approve waste shipping documents. It is the Design-Builder's responsibility to obtain the necessary authorized signatures to ship wastes off-site. Delays or expenses resulting from the untimely waste document coordination shall be borne by the Design-Builder.

3.2.4 Waste Shipment Documentation: EPA Uniform Hazardous Waste Manifest form or such other form or forms required by law or regulation shall be used for all waste transported off-site for hazardous waste disposal. A non-hazardous waste Bill of Lading will be used for all waste transported off-site for disposal or recycling as non-hazardous waste. All waste loads removed from the Project Site will be weighed by a Certified Weighmaster prior to delivery to the disposal facility. Certified weight tickets shall be submitted by the Design-Builder as a part of the Post-job Submittals. At the conclusion of the Work, the Design-Builder will provide documentation that the hazardous waste was disposed of at an appropriate EPA-approved waste disposal facility. The documentation will be submitted as part of the Post-Job Submittals.

3.2.5 Shipment Containers: All waste shipping containers must be individually labeled with appropriate signage and warnings, as required by applicable regulations, codes and ordinances.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

1.1.1 The Criteria Documents indicate site development design intent for the 2118 Milvia Street Project at Berkeley City College, consistent with applicable building codes and standards.

1.1.2 The Criteria Documents show conceptual layout and design, with approximate quantities only. The specifications identify minimum levels of quality, materials and workmanship. If there are differences between this Section and the Criteria Documents submit RFI prior to submittal of Proposal for clarification.

1.2 SITE UTILITIES

1.2.1 General: The Design Builder shall prepare final plans and documents to the applicable codes and standards, obtain the necessary permits and local jurisdiction approvals, and coordinate all systems with final Construction Documents and the District.

1.2.2 Temporary Connections: Various utilities identified on the Criteria Documents requiring relocation may interrupt service to neighboring buildings that are intended to remain in operation. Sequence of construction operations shall be scheduled to minimize time of interrupted service. In some cases, temporary services to these buildings shall be required and shall be provided. Refer to the Criteria Documents for details.

1.2.3 Water: Complete existing and proposed water and fire water system descriptions and design criteria are provided in the Criteria Documents.

1.2.4 Sanitary Sewer: Criteria to be followed when designing the on-site and off-site sanitary sewer systems and descriptions of the existing and proposed sanitary sewer systems are provided in the Criteria Documents.

1.2.5 Electrical: Criteria Documents indicate relocation of existing electrical lines throughout the site. Criteria for equipment, pipe materials, and other requirements can be found in the Criteria Documents. The Design Builder shall prepare final plans and coordinate final design and equipment selection with the electrical vendors, PG&E and the District Representative.

1.2.6 Telecommunications, Fire Alarm, etc. Systems: Criteria Documents indicate routing of new communications utilities and relocation of existing communications utilities throughout the site. Criteria for equipment, pipe materials, and other requirements can be found in the District Standards.

1.3 GRADING AND EROSION CONTROL

1.3.1 The Design Builder shall produce and obtain approval of the site Storm Water Pollution Prevention Plan (SWPPP). Design Builder is responsible for obtaining the NPDES Notice of Intent and Notice of Termination from the State Water Resources Control Board and the District. Design Builder is responsible for implementing all Best Management Practices (BMPs) for preconstruction, construction and post-construction as recommended by the SWPPP document, which is an integral part of the final construction documents. Provide a copy of all such documents to the District Representative for approval.

1.3.2 Erosion control materials shall be stored onsite by the Design Builder and made available for immediate use. BMPs, including the placement of erosion control materials on or near the limits of work, shall be implemented as shown on the final approved SWPPP. Prevention and control measures shall be adjusted as the site conditions change with the phasing of the various areas of construction. All prevention and control measures required by the District, and the State Water Quality Act and incorporated into the SWPPP and BMPs shall be in place at the end of every workday.

1.3.3 Dirt and debris on the Project site and impacts to the neighboring communities is a major concern. Water shall be provided on-site to control dust during construction operations.

1.3.4 Permanent erosion control measures shall be provided as required by the Criteria Documents.

1.4 SITE DEVELOPMENT

1.4.1 Hardscape

1.4.1.1 Paving:

1.4.1.1.1 Primary pedestrian sidewalks are poured-in-place and colored and textured to match the design documents.

1.4.1.1.2 Vehicular traffic and traffic parking areas are generally asphaltic concrete with concrete curbs or curbs and gutters.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 – GENERAL

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.

B. Owner's Project Requirements (OPR) and Basis of Design Document (BOD) are included by reference for information only.

SUMMARY

Section Includes:

1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

As applied to the commissioning requirements for building enclosure (BECx), mechanical (including building automation system), electrical, plumbing (MEPCx), metering systems, security systems, renewable energy and irrigation controls.

Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the Owner's operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:

8. Verify that the applicable equipment and systems are installed in accordance with the contact documents and according to the manufacturer's recommendations.
9. Verify and document proper integrated performance of equipment and systems.
10. Verify that Operations & Maintenance documentation is complete.
11. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.

12. Verify that the Owner's operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.

13. Document the successful achievement of the commissioning objectives listed above.

Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the technical sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The DBE shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.

The commissioning process does not take away from or reduce the responsibility of the DBE to provide a finished and fully functioning product.

Related Requirements:

14. SECTION 01 11 00: SUMMARY OF WORK
15. SECTION 01 11 13: WORK COVERED BY CONSTRUCTION DOUCMENTS
16. SECTION 01 11 20: DESIGN SERVICES AND DELIVERABLES
17. SECTION 01 14 10: CONSTRUCTION MANAGEMENT PLAN
18. SECTION 01 33 50: SUBMITTALS
19. SECTION 01 35 00: CAL GREEN ENVIRONMENTAL REQUIREMENTS
20. SECTION 01 45 00: QUALITY CONTROL
21. SECTION 01 60 00: PRODUCT REQUIREMENTS
22. SECTION 01 70 00: EXECUTION AND CLOSEOUT REQUIREMENTS / DEMONSTRATION AND TRAINING
23. SECTION 01 73 00: EXECUTION
24. SECTION 01 77 00: CLEANING AND CLOSEOUT REQUIREMENTS
25. SECTION 01 81 00: BUILDING INFORMATION MODELLING (BIM) PERFORMANCE REQUIREMENTS
26. SECTION 01 81 13: SUSTAINABABLE DESIGN REQUIREMENTS – LEED V4.1®
27. SECTION 01 89 00: SITE CONSTRUCTION PERFORMANCE REQUIREMENTS
28. SECTION 03 30 00: CAST-IN-PLACE CONCRETE
29. DIVISION 07: COMMISSIONING REQUIREMENTS APPLY TO THE SYSTEM(S) SHOWN IN SECTION 3.9 COMMISSIONED SYSTEMS, OF THIS

DOCUMENT. ALSO REFER TO THE PROJECT CX PLAN FOR ADDITIONAL DETAILS FOR THE ENCLOSURE SYSTEMS BEING COMMISSIONED AND RELATED CHECKLISTS.

30. DIVISION 08: COMMISSIONING REQUIREMENTS APPLY TO THE SYSTEM(S) SHOWN IN SECTION 3.9 COMMISSIONED SYSTEMS, OF THIS DOCUMENT. ALSO REFER TO THE PROJECT CX PLAN FOR ADDITIONAL DETAILS FOR THE ENCLOSURE SYSTEMS BEING COMMISSIONED AND RELATED CHECKLISTS.
31. DIVISION 22: PLUMBING – COMMISSIONING REQUIREMENTS APPLY TO THE SYSTEM(S) SHOWN IN SECTION 3.9 COMMISSIONED SYSTEMS, OF THIS DOCUMENT.
32. DIVISION 23: HEATING VENTILATING AND AIR CONDITIONING – COMMISSIONING REQUIREMENTS APPLY TO THE SYSTEM(S) SHOWN IN SECTION 3.9 COMMISSIONED SYSTEMS, OF THIS DOCUMENT.
33. DIVISION 25: CONTROLS FOR HVAC – COMMISSIONING REQUIREMENTS APPLY TO THE SYSTEM(S) SHOWN IN SECTION 3.9 COMMISSIONED SYSTEMS, OF THIS DOCUMENT.
34. DIVISION 26: ELECTRICAL – COMMISSIONING REQUIREMENTS APPLY TO THE SYSTEM(S) SHOWN IN SECTION 3.9 COMMISSIONED SYSTEMS, OF THIS DOCUMENT.
35. DIVISION 27: COMMUNICATIONS – COMMISSIONING REQUIREMENTS APPLY TO THE SYSTEM(S) SHOWN IN SECTION 3.9 COMMISSIONED SYSTEMS, OF THIS DOCUMENT.
36. DIVISION 28: ELECTRONIC SAFETY AND SECURITY – COMMISSIONING REQUIREMENTS APPLY TO THE SYSTEM(S) SHOWN IN SECTION 3.9 COMMISSIONED SYSTEMS, OF THIS DOCUMENT.
37. SECTION 32 84 00: IRRIGATION

References

38. ASHRAE STANDARD 202-2018 COMMISSIONING PROCESS FOR BUILDING AND SYSTEMS.
39. ASHRAE GUIDELINE 0-2013 THE COMMISSIONING PROCESS.
40. ASHRAE GUIDELINE 1.1-2007, HVAC COMMISSIONING GUIDELINES.
41. ASHRAE GUIDELINE 1.4-2014, PROCEDURES FOR PREPARING FSM.
42. ASTM E2813-2018 STANDARD PRACTICE FOR BUILDING ENCLOSURE COMMISSIONING.
43. ASTM E2947-2016 STANDARD GUIDE FOR BUILDING ENCLOSURE COMMISSIONING.

44. NIBS GUIDELINE 3-2012 BUILDING ENCLOSURE.

45. CAL GREEN.

46. LEED™, NEW CONSTRUCTION REFERENCE GUIDE.

DEFINITIONS

Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

Acceptance Phase: Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.

Approval: Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.

Architect/Engineer (A/E): The prime consultant (architect) and sub-consultants who comprise the design team. As it pertains to commissioning, the A/E is the design professional responsible for the design of the portion of the project being commissioned.

Basis of Design (BoD) document: A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

Building Automation System (BAS): The central building control system and energy management system. Also referred to as a Controls System.

Building Management System (BMS): In general practice, this is just a different name for the BAS.

Building Envelope and Enclosure: The terms “building envelope and “building enclosure” as they refer collectively to all materials, components, systems, and assemblies intended to provide shelter and environmental separation between interior and exterior, or between two or more environmentally distinct interior spaces in a building or a structure.

b. Building Envelope Commissioning (BECx): The process that begins with the establishment of the OPR and endeavors to ensure that the exterior envelope and those elements intended to provide elemental separation within a building or structure meet or exceed the expectations of the Owner as defined in the OPR.

c. Building Envelope Commissioning (BECx) Construction Checklists: A form used by the DBE / subcontractor to verify that appropriate components are onsite, ready for installation, correctly installed, and functional.

d. Building Envelope Testing Matrix: A matrix table developed by the CxA outlining all project specific specified building envelope required testing. Identifying the required test (AAMA and or ASTM or other) to be performed including limits and responsibilities for performing and witnessing of the tests.

Construction-Operations Building Information Exchange (COBie): A performance specification that typically includes documentation from the Operations and Maintenance Data, in addition to other asset identification attributes.

Commissioning (Cx): - A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated and maintained to meet the Owner's Project Requirements.

Commissioning Activity Schedule: A commissioning schedule designed to provide team members with a descriptive overview of commissioning activities as they relate to parallel construction activities regardless of changes to the construction schedule. (See Exhibit B this specification and Cx Plan)

Commissioning Authority (CxA): An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the Commissioning Process. This role is also responsible for commissioning building enclosure systems. The CxA reports directly to the Owner without assuming oversight responsibilities.

Commissioning Coordinator (CxC): A person or entity employed by the DBE to manage, schedule and coordinate the commissioning process.

Commissioning Plan (Cx Plan): A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process. The Cx Plan, where applicable, may include appendices for the BECx Plan and MBCx Plans for one comprehensive commissioning plan document.

Construction Manager (CM): Owner's on-site representative in day-to-day activities, including supervision and management of construction activities.

Contract Documents: They include a wide range of documents that will vary from project to project and with the Owner's needs and regulations, laws, and countries, construction management process, subcontractor agreements or requirements, requirements and procedures for submittals, changes, and other construction requirements, timeline for completion, and other Construction Documents.

Contractor (C) or General Contractor (GC): The person or entity under contract with the Owner pursuant to the Construction Contract to serve as the General Contractor for the construction work. (this project is not using General contractor – rather DBE)

Control System: A component of environmental, HVAC, security and fire systems for reporting, monitoring and issuing of commands.

Computerized Maintenance Management System (CMMS): CMMS is a software toll used to schedule and record the operation and preventative maintenance schedule associated with equipment utilized in the facility.

DBE: Acronym for Design Build Entity. The person or entity under contract with the Owner pursuant to the Construction Contract to serve as the Design Building for the construction work.

Data Logging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.

DDC: Acronym for Direct Digital Controls. This is the most typical controls platform for BAS' / BMS'.

Deferred Functional Tests: Functional Tests that are performed later, after substantial completion, equipment, seasonal requirements, design, or other site conditions that disallow tests from being performed.

Deficiency or Commissioning Issue: A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components.

Factory Testing: Testing of equipment on-site or at the factory, by factory personnel with District's representative present.

Facilities Manager (FM): The Owner representative responsible for the operation and maintenance of the physical facilities and grounds.

Functional Performance Test (FPT): Test of the dynamic function and operation of equipment and systems using, simulations, manual (direct observation) and/or monitoring methods. Systems are tested under various modes. The systems are run through all the control system's sequences of operation and components are verified to be responding as intended per the specified sequence of operations. FPTs are performed after pre-functional checklists and startup is complete and are performed by the DBE / subcontractor and witnessed by the CxA.

Installation Verification: Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.

Integrated System Testing: Integrated Systems Testing procedures entail testing of multiple integrated system's performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, interface between Fire Alarm system and elevator control systems for elevator recall and shutdown; interface

between Fire Alarm System and Security Access Control Systems to control access to spaces during fire alarm conditions; and other similar tests as determined for each specific project.

Issues Log: A formal and ongoing record of problems or concerns and their resolution that have been raised by members of the commissioning team during the course of the commissioning process. Maintained by the CxA.

Monitoring: The recording of equipment operation parameters (flow, current, status, pressure, etc.) using data loggers or the trending capabilities of control systems.

Monitoring Based Commissioning (MBCx): A subset of commissioning that verifies the presence and adequate performance of the metering in a building, in addition to the process of performing monitoring algorithms on a building automation system for predictive maintenance and monitoring.

Owner's Project Requirements (OPR): A collection of documents that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

Owner: Project Owner or designated representative.

Owner-Contracted Tests: Tests paid for by the Owner outside the Contract and for which the CxA does not oversee. These tests will not be repeated during functional tests if properly documented.

Overwritten Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50ºF to 75ºF to verify economizer operation). See also "Simulated Signal."

Phased Commissioning: Commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.

Pre-functional Checklists (PFC): Checklists prepared by the CxA, in conjunction with the Subs, and provided to the DBE / subcontractor to document the complete installation of equipment or systems. These checklists are essentially elementary component tests to verify proper installation of equipment and are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, amp readings, etc.) Pre-functional checklists are completed by the DBE / subcontractors prior to or along with the manufacturer's start-up procedure and checklist.

Pre-Functional Test (PFT): An inspection or test that is done before functional testing. PFT's include installation verification and system and component start up tests.

Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.

Seasonal Performance Tests: Functional Tests that are deferred until the system(s) will experience conditions closer to their design conditions.

Site Observation Visit: On-site inspections and observations made by the Commissioning Agent for the purpose of verifying component, equipment, and system installation, to observe DBE / subcontractor testing, equipment start-up procedures, or other purposes.

Start-up: The initial starting or activating of dynamic equipment or the initial energization and programming of control systems.

Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

Test, Adjust, Balance (TAB): A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as “Testing, Adjusting, and Balancing” and are described in the Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.

Test Procedures: Written details developed by the CxA, and included in the FPTs, that details the expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Thermal Scans: Thermographic pictures taken with an Infrared Thermographic Camera. Thermographic pictures show the relative temperatures of objects and surfaces and are used to identify leaks, thermal bridging, thermal intrusion, electrical overload conditions, moisture containment, and insulation failure.

Trends / Trending: Recordings of control point value history or monitoring value history over time. Trends are automatically recorded by the building automation system or other electronic data gathering equipment. Trend data gathered over a period of time is often used to analyze and verify proper performance of equipment, systems, or sequence of operations.

Training Plan: A written document that details the expectations, schedule and deliverables of commissioning process activities related to training of project operating and maintenance personnel, users and occupants.

Trending: The monitoring by a building management system or other electronic data gathering equipment and analyzing of the data gathered over a period of time to verify proper equipment or systems sequence of operations.

Warranty Phase Commissioning: Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

Warranty Visit: A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

COMMISSIONING TEAM INTERACTION & PROCESS

A project team will be created to coordinate the commissioning effort. This team will coordinate and communicate with the rest of the project team, attend meetings, and solve problems. This team includes representatives from the DBE, subcontractors, and owner.

The DBE shall in addition to their representative also appoint a representative from each subcontractor involved in commissioned systems including mechanical, electrical, controls, test adjust balance, plumbing, building envelope, and security systems.

With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Construction Project Manager (CM). Thus, the procedures outlined in this specification must be executed within the following limitations:

1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Owner and the DBE.
2. Commissioning Issues identified by the Commissioning Agent will be delivered to the Construction Manager and copied to the designated Commissioning Representatives for the DBE and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.
3. In the event that any Commissioning Issues and suggested resolutions are deemed by the Construction Manager to require either an official interpretation of the construction documents or require a modification of the contract documents, the Construction Manager will issue an official directive to this effect.
4. All parties to the Commissioning Process shall be individually responsible for alerting the Construction Manager of any issues that they deem to constitute a potential contract change prior to acting on these issues.
5. Authority for resolution or modification of design and construction issues rests solely with the Construction Manager, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

OWNER'S RESPONSIBILITIES

Participate in resolution of issues that may occur as a result of the commissioning process.

Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:

6. Coordination meetings.
7. Training in operation and maintenance of systems, subsystems, and equipment.
8. Testing meetings.
9. Demonstration of operation of systems, subsystems, and equipment.
10. Provide feedback to Cx for the project warranty phase testing and review, as well as access to the site and controls system during the warranty test.

COMMISSIONING COORDINATION RESPONSIBILITIES

Design Build Entity (DBE) Responsibilities

11. Provide utility services required for the commissioning process.
12. DBE is responsible for construction means, methods, job safety, or management function related to commissioning on the job site.
13. DBE shall assign representatives with expertise and authority to act on behalf of the DBE and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
    1. Participate in construction-phase commissioning meetings including controls coordination meeting to review and resolve any issues with the sequence of operations.
    2. Participate in maintenance orientation and inspection.
    3. Participate in operation and maintenance training sessions.
    4. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
    5. Perform quality control of all work and certify it is complete prior to request for inspection.
    6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
14. DBE shall integrate all commissioning activities into DBE’s master construction schedule.
15. DBE shall provide a means to effectively commission the BMS system including the following at minimum:
    1. Schedule the controls DBE that was an integral part of programming the building BMS to run the tests
    2. Provide a table with chairs

3. Provide a 17” 1080p monitor with 10' cables for connection to the controls DBE’s laptop.

16. DBE or Subcontractors shall provide a COBie information or delivery plan acceptable to the scope of work described in Specification Sections: 01 33 00, 01 60 00, 01 70 00, 01 73 00, 01 77 00, and 01 81 13.

17. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

    1. Participate in construction-phase coordination meetings.

    2. Participate in maintenance orientation and inspection.

    3. Complete pre-functional checklists for all equipment. Submit completed forms with start-up reports immediately after start up.

    4. Complete building enclosure construction checklists as required throughout the installation of building enclosure systems as identified. Submit completed forms upon installation completion of each building enclosure system.

    5. Schedule and perform building enclosure testing as specified in the technical specification sections with CxA as witness.

    6. Schedule and perform duct air leakage testing as specified in the technical specification sections with CxA as witness.

    7. Provide flushing plans, disinfection reports and water treatment reports to the CxA for review.

    8. Participate in pre-TAB meeting and jobsite inspections to verify TAB readiness.

    9. Provide draft completed TAB report to CxA for review. CxA will identify up to 20% of TAB report for TAB subcontractor to demonstrate compliance to the completed TAB report.

    10. Participate in procedures meeting for testing.

    11. Perform point-to-point, calibration and checkout of the building automation system and provide completed report to the CxA for review.

    12. Participate in final review at acceptance meeting.

    13. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.

    14. Provide information to the CxA for developing construction-phase commissioning plan.

15. Participate in training sessions for operation and maintenance personnel.
16. Verify that all systems function correctly by testing each mode of operation, alarm and system function.
17. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified.
18. Perform quality control of all work and certify it is complete prior to request for inspection.
19. Complete and sign Systems Functional Testing Readiness Certification and Notification Letter for Commissioning and provide to CxA (See EXHIBIT A of this specification section).
20. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.
21. DBE to provide to the CxA control point history trend reports of energy and water meter data aggregated by monthly usage for each meter and any related calculated metering trends. Provide these trends for a full year of data once meters have been confirmed to be reporting correctly.
22. DBE to provide to the CxA control point history trend reports of all systems operation at startup and post occupancy.
23. DBE to provide to the CxA the design lighting levels per each space.
24. DBE to provide to the CxA the building occupancy schedules and equipment run time schedules for the “as-built” condition(s).
25. DBE to provide to the CxA the As-Built drawings / documents. Including the BoD, and as-programmed setpoints and minimum outside air requirements for each system.
26. Perform seasonal testing, at the direction of the CxA, to prove functional performance of the HVAC and controls in the opposite season.
27. Perform 10-month Cx warranty review. Intent is to review the operation of the commissioned systems onsite prior to the expiration of warranty. DBE should be prepared to review open Cx Master Issues Log items for completion, warranty log issue review, as well assessment of the functionality and operation of the commissioned building systems. Input will be solicited from building owners on operation and performance of the building systems.

Architect and Design Engineer Responsibilities

18. Responsible for developing the construction contract documents and clarifying the design intent during the construction phase of the project.

19. Performs construction observation.
20. Contracted to DBE.
21. Coordinate with the CxA specified building enclosure test plans developed by the architect and or CxA.

CxA's Responsibilities

22. Organize and lead the commissioning team.
23. Prepare a Commissioning Plan. Collaborate with design team, owner, DBE and subcontractors to develop test and inspection procedures. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.
24. Work with the DBE to schedule commissioning activities. The DBE shall integrate all commissioning activities into the master construction schedule. All parties will address scheduling issues in a timely manner in order to expedite the commissioning process.
25. Review and comment on submittals for compliance with the approved project documents and identify any potential conflicts.
26. Conduct commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes. The CxA shall prepare and distribute minutes to commissioning team members and attendees within five (5) workdays of the commissioning meeting.
27. At the beginning of the construction phase, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for permanent power; operation and maintenance data submittals; operation and maintenance training sessions; TAB Work; and Project completion.
28. Periodically observe and inspect construction and report progress and deficiencies. In addition to compliance with the Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.
29. Prepare Project-specific pre-functional checklists, functional test procedures checklists, and building enclosure construction checklists.
30. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.
31. Review and comment on operation and maintenance documentation for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 Section "Operation and Maintenance Data."

32. Review DBE's operation and maintenance training program. Operation and maintenance training is specified in Division 01 Section "Demonstration and Training."
33. Prepare commissioning status reports.
34. Perform and direct warranty functional testing and site review at a point in time 10 months after the start of warranty.
35. Assemble the final commissioning documentation, including the Commissioning Report including applicable Project Record Documents.

COMMISSIONING DOCUMENTATION

Commissioning Plan: A document, prepared by CxA, that outlines the process, schedule, allocation of resources, and documentation requirements of the commissioning effort, and shall include, but is not limited to the following:

36. Description of the organization, layout, and content of commissioning documentation to be provided along with identification of responsible parties.
37. Identification of systems and equipment to be commissioned.
38. Description of the level of commissioning for each system
39. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
40. Identification of items that must be completed before the next operation can proceed.
41. Description of responsibilities of commissioning team members.
42. Description of observations to be made.
43. Description of requirements for operation and maintenance training, including required training materials.
44. Provide a schedule for commissioning activities with specific dates coordinated with overall construction schedule.
45. Define the process for completing pre-functional and startup checklists for systems, subsystems, and list of specific equipment requiring these checklists.
46. Include Step-by-Step procedures for Functional Testing of systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.

Pre-Functional Checklists: CxA shall develop pre-functional checklists for all equipment to be commissioned. Pre-Functional Checklists shall be completed and signed by the DBE / subcontractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent may spot check Pre-Functional Checklists to verify accuracy and readiness for testing. Inaccurate or

incomplete Pre-Functional Checklists shall be returned to the DBE / subcontractor for correction and resubmission.

Site Visit Reports: CxA shall record test data, observations, and measurements on site visit forms. Updated Issues Log, photographs and other means appropriate for the application shall be included with Report.

Start-Up Reports: Subcontractor/Manufacturer created forms that document that factory start-up procedures have been followed for all equipment and systems to be commissioned. Provided by subcontractors.

Functional Performance Testing: CxA shall develop functional performance test procedures for all equipment and systems to be commissioned. Site Visit Reports: CxA shall record test data, observations, and measurements on site visit forms. Photographs and other means appropriate for the application shall be included with data.

Building Enclosure Construction Checklists: CxA shall develop BECx checklists for the installation and verification of procedures.

Test and Inspection Reports: CxA shall compile test and inspection reports and test and inspection certificates and include them in Systems Manual and commissioning report.

Commissioning Schedule: CxA shall review and provide input to the master project and construction schedules for commissioning activities.

Issues Log: CxA shall prepare and maintain an issues log that describes installation, and performance issues that are at variance with the Contract Documents. CxA will identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.

47. Creating an Issues Log Entry:
    1. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
    2. Assign a descriptive title of the issue.
    3. Identify issue date.
    4. Include information that may be helpful in diagnosing or evaluating the issue.
    5. Note recommended corrective action.
    6. Identify commissioning team member responsible for corrective action.
    7. Identify person documenting the issue.
48. Documenting Issue Resolution:
    1. Log date correction is completed or the issue is resolved.
    2. Collect descriptions from contracting team.

a. of corrective action or resolution taken
b. description of diagnostic steps taken to determine root cause of the issue, if any.
c. Statement that the correction was completed and system, subsystem, and equipment are ready for retest, if applicable.

Commissioning Report: CxA shall document results of the commissioning process including performance of systems, subsystems, equipment and issues. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the OPR, BoD and Contract Documents. The commissioning report shall include, but is not limited to, the following:

49. Discussion of performance of commissioned systems including any variance from OPR, BOD and the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during OWNER occupancy and operation. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.
50. Commissioning Plan.
51. Testing plans and reports.
52. Issues log.
53. Completed test checklists.
54. Listing of off-season test(s) not performed and a schedule for their completion.

Systems Manual: CxA shall gather required information and compile Systems Manual. Systems manual shall include, but is not limited to, the following:

55. As-built system narratives, schematics, and list of installed equipment
56. Operation and maintenance data

CXA SUBMITTALS

Commissioning Plan: CxA shall submit a draft commissioning plan. Deliver one copy to DBE and one to OWNER. Present submittal in sufficient detail to evaluate data collection and arrangement process. One copy, with review comments, will be returned to the CxA for preparation of the final commissioning plan.

Pre-functional Checklists: CxA shall submit sample checklists and forms to DBE and subcontractors for review, comment and approval. DBE / subcontractor completed pre-functional checklists are required to be submitted for review and approved prior to proceeding with functional performance testing.

Functional Test Plan: CxA shall submit draft Functional Test Plan and checklists for comment. The final Functional Test Plan will be submitted and used for functional testing.

Site visit reports: CxA shall submit site visit reports as they are created.

Final Commissioning Report: CxA shall submit the draft commissioning report. One copy, with review comments, will be returned to the CxA for preparation of final submittal. The final report submittal must address previous review comments.

The CxA will provide appropriate DBE / subcontractors with a specific request for the type of submittal documentation the CxA requires facilitating the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum the request will include the manufacturer and model number, the manufacturer printed installation and detailed start-up procedures, sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details. In addition, the factory checkout sheets or field technicians shall be submitted for review

COORDINATION

Scheduling: The DBE shall work with the Commissioning Agent to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the DBE to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The DBE shall update the Master Construction schedule as directed by the Owner.

Coordinating Meetings: CxA shall conduct coordination meetings of the commissioning team as needed to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

Pretesting Meetings: CxA shall conduct pretest meetings with the commissioning team to review startup reports, coordinate controls sequence of operations, review pretest inspection results, review testing and balancing procedures, review testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.

Testing Coordination: CxA shall coordinate with the Owner representative and DBE to plan the sequence of testing activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

57. Schedule times for tests, inspections, obtaining samples, and similar activities.

e. The Subcontractors shall provide sufficient notice to the CxA (2 weeks minimum) regarding their completion schedule for the pre-functional checklists and startup of all equipment and systems. The DBE / subcontractor(s) will use the Readiness Letter in EXHIBIT A to notify the CxA that the systems are ready.

General

1. Functional testing is conducted after pre-functional testing and startup has been satisfactorily completed.
2. The BAS is sufficiently tested and approved by the CxA before it is used for TAB or to verify performance of other components or systems.
3. The air and water balancing is completed and approved before functional testing of air-related or water-related equipment or systems.
4. Testing proceeds from components to subsystems to systems.
5. When the proper performance of all interacting, individual systems has been achieved, the interface or coordinated responses between systems is checked.

PRODUCTS (Not Used)

EXECUTION

BUILDING ENCLOSURE CONSTRUCTION CHECKLISTS

Building Enclosure Construction Checklists are developed by the CxA and completed by the appropriate installing subcontractors for all major building enclosure systems being commissioned. The checklists are to be completed during the installation phase of each system. These checklists are to ensure that each building enclosure system is being installed according to the specified installation standards. The building enclosure checklists are in addition to the manufacturer's installation checklists and DO NOT replace the manufacturer's installation checklists. The Subcontractor and vendors shall also execute manufacturer's installation checklists and provide CxA with a copy of the signed and dated completed checklists which will be submitted with the Building Enclosure Construction Checklists.

Execution of Building Enclosure Construction Checklists

6. Construction checklists will be provided to the CM and DBE by the CxA.
7. The DBE shall maintain a master copy of signed checklists.
8. The installing subcontractors shall update the checklists as work is completed. Only individuals that have direct knowledge and witnessed that a line-item task on the pre-functional checklist was actually performed shall initial or check that item off.
9. The CxA will periodically review the checklists for completeness and report on progress at the Cx meetings.

SUBMITTALS

The CxA shall provide the Design Builder with a specific request for the type of submittal documentation required to facilitate the commissioning work. These requests shall be integrated into the submittal process and protocol of the project.

The submittal shall be reviewed and approved by the Design Builder's design team prior to being submittal to the CxA.

At minimum, the submittal request shall include:

10. Equipment manufacturer and model number.
11. Selection and operating data (Example: Flows, pressures, temperatures, fan curves, etc.).
12. The manufacturer's printed installation and detailed start-up procedures.
13. Full sequences of operation and control drawings.
14. O&M data, performance data, performance test procedures, details, and results of owner-contracted tests.
15. Installation and checkout materials that are shipped inside the equipment and the manufacturer field checkout sheet forms to be used by the factory or field technicians.

The CxA shall review and approve submittals related to the commissioned equipment for conformance to the Owner Project Requirements, Design documents and as it relates to the commissioning process, the functional performance of the equipment, completeness and adequacy for developing test procedures.

The CxA's review is intended to aid in the development of functional testing procedures and to verify compliance with equipment specifications. The Commissioning authority shall notify the Owner and the DB of items missing or areas that are not in conformance with contract documents or Owner Project Requirements and which require resubmission.

The CxA may request additional design narrative from the A/E and Controls Subcontractor, depending on the completeness of the basis of design documentation and sequences provided with the design document Specifications.

These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Design Builder, though the CxA will review and approve them.

PRE-FUNCTIONAL CHECKLISTS AND FACTORY START UP REPORTS

The following procedures apply to all equipment to be commissioned.

Pre-functional Checklists are developed by the CxA and completed by the appropriate installing DBE / subcontractors for all major equipment and systems being

commissioned before functional testing can begin. The checklist captures equipment nameplate and characteristics data, confirming the as-built status of the equipment or system. These checklists also ensure that the systems are complete and operational, so that the functional performance testing can be scheduled. The Subcontractors and vendors shall execute factory startup and provide the CxA with a copy of the signed and dated completed start-up checklists which will be submitted with the Pre-Functional checklists.

Startup and Initial Checkout Plan: The Subcontractor shall develop detailed startup plans for all equipment. The primary role of the DBE / subcontractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been followed and completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.

16. The full startup plan shall at a minimum consist of the following items:
    1. The Pre-Functional Checklists.
    2. The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
    3. The manufacturer's normally used field checkout sheets.

The Commissioning Agent will review/approve the full start-up plan.

Execution of Pre-functional Checklists and Startup.

17. Pre-Functional checklists will be provided to the project site by the CxA.
18. The DBE shall maintain a master copy of signed checklists.
19. The installing subcontractors shall update the checklists as work is completed. Only individuals that have direct knowledge and witnessed that a line-item task on the pre-functional checklist was actually performed shall initial or check that item off.
20. The CxA will periodically review the checklists for completeness and report on progress at the Cx meetings.
21. DBE will provide electronic copies of completed checklists to the CxA.

BAS Startup Testing, Adjusting, and Calibration

22. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. DBE / Subcontractor shall start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:
    1. Inspect the installation of all devices. Review the manufacturer’s installation instructions and validate that the device is installed in accordance.

2. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.

3. Verify integrity/safety of all electrical connections.

4. Coordinate with TAB subcontractor to fine tune control settings that are determined from balancing and testing procedures. Record the following control settings as obtained from TAB subcontractor, and note any TAB deficiencies in the BAS, Pre-functional checklists and initiate an associated Action Item:

    a. Optimum duct static pressure setpoints for VAV air handling units.

    b. Minimum outside air damper settings for air handling units.

    c. Optimum differential pressure setpoints for variable speed pumping systems.

    d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.

    e. BAS subcontractor shall provide access to the front-end Building Automation System as a minimum to the TAB and CxA to facilitate calibration. Connection for any given device shall local to it (i.e: at the VAV box or at the thermostat). Shall be made at front end and shall allow querying and editing of parameters required for proper calibration and start up.

5. Test, calibrate, and set all digital and analog sensing, and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS display and the reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range). Record the measured value and displayed value for each device in the BAS Pre-functional Report.

6. Check each digital control point by making a comparison between the control command at the controller and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the OI display. Record the results for each device in the BAS Pre-functional checklists.

7. Verify proper sequences by using the approved checklists to record results and submit with BAS Pre-functional checklists. Verify proper sequence and operation of all specified functions. There is inherent duplication between the functional performance testing of the Testing Subcontractor, and the thorough checking testing of the sequences by the BAS. Generally, the sequence checkouts indicated as the responsibility of the

Testing Subcontractor under functional testing, must first be tested by the BAS under pre-functional testing.

8. Verify proper systems operation under emergency power. Cooperate and coordinate with Testing Subcontractor and CxA for comprehensive building power outage tests.
9. Verify all safety devices trip at appropriate conditions. Adjust setpoints accordingly.
10. Verify that all alarm thresholds for all analog devices are entered. Request direction from Owner as to alarm threshold parameters.
11. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot.

For interface and DDC control panels:

23. Ensure devices are properly installed with adequate clearance for maintenance and clearly labeled in accordance with the record drawings
24. Ensure terminations are safe, secure and labeled in accordance with the record drawings
25. Check power supplies for proper voltage ranges and loading.
26. Ensure wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
27. Check for adequate signal strength on communication networks.
28. Check for stand-alone performance of controllers by disconnecting the controller from the LAN. Verify the event is enunciated at OIs. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
29. Ensure that controller memory and control network through-put are adequate to support the extensive trending requirements. Reconfigure the system to provide a reliable and robust system as necessary.
30. Ensure all outputs and devices fail to their proper positions/states.
31. Ensure buffered and/ or volatile information is held through power outage.
32. With all system and communications operating normally, sample and record update/enunciation times for critical alarms fed from the panel to the OI.
33. Check for adequate grounding of all DDC panels and devices.

Meters

34. All meters (Electric, Gas, Water) calibration will be verified in the field after installation.

35. All Meters will be verified by the DBE / subcontractor to be reporting correctly; including – correct units, intervals, and trending back to the DDC controls system operator workstation graphics.

For Operator Interfaces:

36. Verify all elements on the graphics are functional and properly bound to physical devices and/or virtual points and that hot links or page jumps are functional and logical.
37. Output all specified system reports for review and approval.
38. Verify the alarm printing and logging is functional and per requirements
39. Verify trend archiving to disk and provide a sample to the CxA for review.
40. Verify paging/dial out alarm enunciation is functional.
41. Verify functionality of remote OIs and that a robust connection can be established consistently.
42. Verify that required third party software applications required with the bid are installed and functional.
43. Verify proper interface with fire alarm system.

Submit Start-Up Test Report. Report shall be completed, submitted and approved prior to functional testing.

Deficiencies, Non-Conformance and Approval in Checklists and Startup.

44. The DBE / Subcontractor shall clearly list any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.
45. The CxA reviews the report and reports to the Owner Representative. The CxA shall work with the DBE / subcontractor and vendors to correct and retest deficiencies or uncompleted items.

FUNCTIONAL PERFORMANCE TESTING

Common Elements for All Systems

46. Have the required submitted documentation convenient to testing area. Validate that all required documentation has been submitted and is per the contract requirements (very cursory review). CxA shall review the content of the documentation and validate that it is per contract documents.
47. CxA shall review the startup documentation at the start of functional performance testing. Review the startup tests and checklist documentation. CxA shall validate that startup is acceptably executed and complete. CxA shall ensure that any

items indicated as outstanding in the checklists is entered as an Action Item and enter one if it is not. The checklists and start up tests/measurements shall be spot checked at the beginning of FPT to ensure accuracy. CxA shall complete a test that indicates he has reviewed the pre-functional checklists and finds them acceptable and note any outstanding items.

48. CxA shall check for and as applicable direct DBE / subontractor to demonstrate that access is sufficient to perform required maintenance.
49. CxA shall validate that all prerequisite work is complete and confirm via a test record that the CxA feels it is.
50. Specifically check labeling and ensure conformance to contract requirements.
51. Check proof indication, alarming on failure and restart/acknowledgement as applicable.
52. CxA shall observe operating conditions encountered at the start of FPT. CxA shall examine for normal functionality and record parameters as a test.
53. All dynamic systems powered by electricity shall be tested to simulate a power outage to ensure proper sequencing. Those on emergency power or uninterruptible power shall be tested on all sources.
54. CxA shall inspect the installation and compare it to contract requirements. Record the inspection as a test.
55. Capacities and adjusted and balanced conditions as applicable will generally be checked.
56. Verify all sequence modes and sequences of operation. CxA must initiate all modes and may not refer to or rely on a pre-functional test done by the BAS. Some examples of generic modes that apply to most systems include:
    1. Off Mode
    2. Failed Mode: Proof, safeties, power outage etc. See below for stress testing.
    3. Start Sequence in various modes
    4. Stop sequences in various modes
57. All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe and stable operation.
58. Dynamic Graphics: The graphic for all components, systems, and areas sampled and required to be represented by a graphic shall be checked for adequacy and accuracy. Furthermore, when setpoints are required to be adjustable, verify that they can be adjusted directly from the graphic screen.

59. All interfaces between two systems or equipment of different manufacturers must be checked for accuracy and functionality.

60. “Stress Testing”: CxA shall analyze systems to identify possible conditions where functionality may be compromised. CxA shall design non-destructive tests that will demonstrate either the automated response to the conditions or so that team can identify the best method for responding or fixing the condition. All tests and finding shall be documented.

61. COBie Data: The Construction-Operations Building Information Exchange (COBie) for each piece of equipment is to be provided during the submittal phase. Information included in the COBie submittal should contain at minimum the manufactures O&M manuals, physical location, asset information including, but not limited to the manufacture’s serial and model numbers, the owner’s equipment identification tag, and installation date. Since COBie Data is available in many different formats, a compatible format is to be provided that will work with the owners Computerized Maintenance Management Software (CMMS). In general, information pertinent to Specification 01 78 00 shall be included in the COBie.

Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the Contract Documents. Each system will be tested to verify that the system response is as designed. HVAC systems will be checked for conformance to the design sequences of operation and stable control, lighting control will be checked in each type of lighting area, security system cameras will be verified functional and able to see the correct areas. Proper system responses to such conditions as power failure, out of limit condition, equipment failure, etc. shall also be tested.

Early duct air leakage tests shall be performed to ensure green and building code compliance. Point-to-point testing will be performed by controls subcontractor on all applicable systems, with results given to CxA prior to functional performance testing.

Development of Test Procedures: The test procedures are written by the CxA based upon the final operational sequences from available project documentation. The CxA shall develop specific test procedures and forms to verify and document proper operation of each system. Prior to execution, the CxA shall provide a copy of the test procedures to the DBE / subcontractor who shall review the tests for feasibility, safety, equipment and warranty protection. The test procedure checklists developed by the CxA shall include the following information:

62. System and equipment or component name(s).

63. Equipment location and ID number.

64. Date.

65. Project name.

66. Participating parties.
67. Reference to the specification section describing the test requirements, if applicable.
68. A copy of the specific sequence of operations.
69. Prerequisites for the test.
70. Special cautions, alarm limits, etc.
71. Specific step-by-step procedures to execute the test.
72. Acceptance criteria of proper performance with a Yes / No/NA check box.
73. A section for comments.

Test Methods.

74. Systems Functional Performance Testing shall be achieved by manual testing (i.e., persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The DBE / Subcontractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.
    1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
    2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
    3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
    4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 54 F (12 C), when the outside

air temperature is above 54 F (12 C), temporarily change the lockout setpoint to be 4 F (2 C) above the current outside air temperature.

5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout

75. Functional testing is performed by the subcontractors with the method and degree of testing as defined in this specification for each system. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Subcontractor executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Subcontractor shall return all affected building equipment and systems to their pre-test condition.

76. Multiple identical pieces of equipment may be functionally tested using a sampling strategy. The sampling strategy will be defined in these specifications with the commissioned systems list.

f. Coordination and Scheduling: See the *COORDINATION* section for coordination and scheduling details.

g. Problem Solving: The CxA will recommend solutions to problems found; however, the burden of responsibility to solve, correct and retest problems is with the DBE / Subcontractor and Owner's consultants.

FUNCTIONAL PERFORMANCE TESTING OF METERING

Objectives and Scope. The objective of metering functional performance testing is to demonstrate that each meter is operating according to the Contract Documents and tested to verify that the system performance is as designed.

Problem Solving: The CxA will recommend solutions to problems found; however, the burden of responsibility to solve, correct and retest problems is with the DBE / Subcontractor and Owner's consultants.

Coordination and Scheduling: See the *COORDINATION* section for coordination and scheduling details.

FUNCTIONAL PERFORMANCE TESTING OF BUILDING ENCLOSURE SYSTEMS

Objectives and Scope: The objective of functional performance testing of building enclosure systems is to help ensure that each enclosure system is installed and functions according to Facility Design Standards and the Contract Documents. Various building

enclosure systems will be selected for testing which will be performed on the mock-up and or in-situ testing. Testing will be performed in accordance with ASTM and or AAMA testing standards as specified in each applicable section of these specifications and or as defined by the Building Enclosure Test Plan as provided by the architect.

Coordination and Scheduling (BECx)

1. Conduct building enclosure testing before installation of insulation and interior closure of the wall. The exterior sections of the building envelope assemblies shall be completed with discrepancies and problems remedied before testing of the exterior wall system or mock-up assemblies.

2. Building enclosure subcontractors will provide installation foremen to witness execution of building enclosure tests conducted on the mock-up assemblies to resolve installation issues and establish future installation practices necessary to correct deficiencies observed prior to commencing with installation of the exterior wall systems. DBE / subcontractors will ensure that the installation foremen are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.

3. The CxA will witness DBE / subcontractor performed building enclosure testing. The DBE / subcontractor will be responsible to provide 14 days' notice to the CxA regarding their testing schedule for DBE / subcontractor performed building enclosure testing. The DBE / subcontractor will use the Testing Readiness letter in EXHIBIT A to notify the CxA that the systems are ready.

Deficiencies, Non-Conformance (BECx)

4. The CxA will record the results of building enclosure functional test on a Testing Report. All deficiencies or non-conformance issues shall be noted on the Cx Master Issues Log and reported to the DBE.

5. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the Testing Report.

6. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosing acceptance criteria to satisfy scheduling or cost.

7. A complete round of tests will be performed, with results and deficiencies reported to the DBE and subcontractors. The responsible subcontractors will then have and the opportunity to correct the deficiencies and schedule re-testing. One CxA retest witnessing of failed test area will be provided by CxA at no additional charge. Cost of additional CxA re-test witnessing is outlined by the next section.

8. If there is a dispute about a deficiency the deficiency shall be documented on the Cx Master Issues Log with the DBE / subcontractor's response. The final interpretive authority is the AOR.

OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

Before the operation and maintenance training, CxA shall review training preparation for compliance with project documents.

Training is required per contract specifications. At a minimum, training is required for Mechanical systems, Lighting, and Controls systems.

The CxA requires submission of training records including attendance lists to verify appropriate people received the training.

GENERAL WARRANTY AND SEASONAL TESTING REQUIREMENTS

h. Coordinate MEP and Building Enclosure Subcontractor Call-back and Warranty Enforcement.

1. Perform review of commissioned systems:

1. Timed at approximately 2 months prior to the expiration of the project warranty period.
2. Project warranties have a typical duration of 12 months. Verify for this project.
3. The Warranty Period walk through inspection for the commissioned systems and building enclosure would then be typically scheduled at 10 months and should include representatives from the Owner, A/E, Facilities Management, CM, GC, subcontractors and manufacturers.

MEP Cx WARRANTY AND SEASONAL TESTING REQUIREMENTS

The Warranty Phase of a project can incorporate one or both of these two complimentary activities:

2. Seasonal Testing: Seasonal variation in operations or control strategies may require additional testing during peak cooling and heating seasons to verify systems performance. If the project finishes in the summer, testing of the heating systems may not be effective or conclusive, and can be postponed to colder weather if seasonal testing is included in the scope. The CxA coordinates this activity. Tests are executed and deficiencies corrected by the appropriate subcontractors, witnessed by Owner's staff and the CxA.

3. Warranty Testing: The CxA will perform an evaluation of the systems in the Cx scope to provide additional experienced review of operation prior to the expiration the warranty. The CxA will request input from the Owner's operations staff and occupants about the performance of the building systems, as well as perform targeted evaluation of systems and controls. Additionally, open items on

the Master Issues Log are often reviewed for completion, or significant issues observed during previous phases are evaluated to ensure they are still in a corrected state. A warranty walk review typically is performed onsite. However, videoconference and BMS remote review by the CxA may be arranged in place of the onsite warranty walk.

These two activities often have overlapping scope and intent and will be performed during the same site evaluation(s), where possible.

The warranty period typically begins at the project's Substantial Completion or shortly thereafter.

BECx WARRANTY TESTING REQUIREMENTS

Building Enclosure warranty activities align with NIBS Guideline 3-2012 Building Enclosure Commissioning Process BECx and include the following additional activities:

4. CxA will coordinate with the Owner, CM, GC to arrange a building enclosure warranty walk.
5. The warranty walk review is generally performed onsite. However, a videoconference review by the BECxA may be arranged in place of the onsite warranty walk.
6. The Cx Master Issues log will be distributed by the CxA highlighting any unresolved "open" issues discovered during the construction phase.
7. Participation by the Owner's operations staff is required.
8. A report will be issued summarizing the warranty walk process, findings and open issues needing to be addressed by the GC.

COSTS OF COMMISSIONING WORK (MEPCx, BECx)

The cost to the DBE and Subcontractors to comply with the specified requirements and to support the work of the CxA shall be included in the DBE's and Subcontractor's bid price.

It is the DBE / subcontractor's responsibility to QC and pre-test all building equipment and systems. The CxA shall confirm function of each system. If a device, piece of equipment, sequence, or system fails a test, corrections shall be made immediately and retested.

If at any point in the Commissioning Functional Testing Process, should an issue or failure arise that requires significant time to correct or cannot be corrected immediately during the testing process, that results in a delay or prevents the CxA from completion of the functional testing, incurred costs shall be reimbursed by the DBE. The associated costs of re-testing are defined in Exhibit A - Readiness Letter (FTRL).

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for the demolition and removal of pavement sections, sidewalks, curbs and gutters, trees, and utilities as indicated.

B. Extent of demolition work shall be as follows: Removal and disposition of existing pavement sections, curbs and gutters, sidewalks, trees, utilities, and site improvements which interfere with construction

C. Restoration and adjustment of existing structures and facilities to remain in place which are damaged by demolition and removal operations.

1.2 RELATED SECTIONS

A. Section 01 50 00 - Temporary Facilities and Controls

1.3 REFERENCES

A. American National Standards Institute (ANSI)
ANSI A10.6 Safety Requirements for Demolition Operations

B. California Code of Regulations (CCR)

CCR Title 8, Chapter 4, Subchapter 4 – Construction Safety Orders
CCR Title 24, Part 2, California Building Code, Chapter 33, Section 3303, Protection of Pedestrians during Construction or Demolition

1.4 PERMITS

A. Obtain all special permits and licenses and give all notices required for performance and completion of the demolition and removal work, hauling, and disposal of debris.

1.5 SUBMITTALS

A. Demolition Plan

1. Submit a comprehensive demolition plan, describing the proposed sequence, methods, and equipment for demolition, removal, and disposal of structure(s); include salvage if required. Do not proceed with demolition until the designated approval authority has approved the demolition plan.

B. Permits

1. City of Berkeley Encroachment permit. Contractor shall obtain an encroachment permit for all work within the public right-of-way, as indicated.

2. Contractor shall submit copies of demolition, hauling, and debris disposal permits and notices for record purposes. Include description of proposed haul routes.

1.6 SITE CONDITIONS

A. Erect and maintain temporary bracing, shoring, lights, barricades, signs, and other measures as necessary to protect the public, workers, and adjoining property from damage from demolition work, all in accordance with applicable codes and regulations.

B. Open depressions and excavations occurring as part of this work shall be barricaded and posted with warning lights when accessible through adjacent property or through public access. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

C. Protect utilities, pavements, and facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by demolition operations.

D. Protection of Utilities: Protect active sewer, water, gas, electric, and other utilities; and drainage and irrigation lines indicated or, when not indicated, found or otherwise made known to the Contractor before or during demolition work.

E. Maintain existing utilities and protect from damage as necessary to satisfy the requirements of jurisdictional utility companies and related codes and regulations.

F. Make arrangements with affected utility companies and Owners to provide the information and services necessary to coordinate and complete the Work.

G. Do not disconnect or shut down any part of the existing utilities and services, except by permission of authorities having jurisdiction. Submit schedule of estimated shut-down time in order to obtain such permission, and notify all interested parties, utilities, and municipal and county authorities, as required.

H. Utilities to be removed shall not be removed until shut-down time can be kept to a minimum. Do not remove an existing utility line or service until the replacement line, crossover, or capping is ready to be performed.

I. Notify the Engineer and utility owners 72 hours before performing any excavation work. Notify affected utilities by calling Underground Service Alert (USA) at 1-800-227-2600. Contact utility owners not covered by USA, by calling the affected utility owners directly.

J. Protect active underground utilities from damage. If underground utilities are damaged in any way, notify the Engineer and affected utilities immediately for corrective action.

K. Noise and Dust Abatement: Comply with requirements specified in Section 01 50 00 - Temporary Facilities and Controls. In addition, provide continuous noise and dust abatement as required to prevent disturbance and nuisance to the public and workers and to the occupants of adjacent premises and surrounding areas. Dampen or cover areas affected by demolition operations as necessary to prevent dust nuisance.

L. The Contract Drawings and related documents may not represent all surface conditions at the site and adjoining areas. The known surface conditions are as indicated, and shall be compared with actual conditions before commencement of work.

M. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other such surface fixtures.

N. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the work until written instructions are received from the Engineer.

O. Thicknesses of existing pavements are unknown. Remove pavement of whatever thickness as required.

P. Remove Tree (Grind Roots). Contractor shall remove and dispose of trees and other plant material where shown on Contract Plans and as directed by the Engineer. Tree removal shall include the removal of any roots or trunks in conflict with the work to a depth of fifteen (15) inches below existing grade, or as directed by the Engineer. All resulting tree, shrub, and other excavation material shall be disposed of outside the street right-of-way as required in Section 7-1.13 of the Standard Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS, EQUIPMENT, AND FACILITIES

A. Furnish all materials, tools, equipment, devices, appurtenances, facilities, and services as required for performing the demolition and removal work.

PART 3 - EXECUTION

3.1 PRESERVATION OF REFERENCE MARKERS

A. Record the locations and designation of survey markers and monuments prior to their removal. Provide three reference points for each survey marker and monument removed, established by a licensed civil engineer or land surveyor currently registered in the State of California.

B. Store removed markers and monuments during demolition work, and replace them upon completion of the work. Re-establish survey markers and monuments in conformance with the recorded reference points. Forward to the Engineer a letter verifying re-establishment of survey markers and monuments, signed by a licensed civil engineer or land surveyor currently registered in the State of California.

3.2 DEMOLITION

A. Perform demolition in accordance with the approved Demolition Plan.

B. Operational procedures shall be in accordance with the approved Demolition Plan.

C. Demolish concrete and masonry in small sections. Perform demolition with small tools as much as possible. Blasting will not be permitted.

D. Cap and plug pipe and other conduits abandoned due to demolition, with approved type caps and plugs as required by the utility owners.

E. Backfill and compact depressions caused by excavations, demolition, and removal in accordance with the requirements of Section 31 20 00 - Earth Moving.

3.3 RESTORATION OF EXISTING STRUCTURES AND FACILITIES

A. All damage to existing structures and facilities, including utilities, which are to remain in place, shall be repaired to a condition equal to that existing prior to the beginning of demolition and removal operations. The cost of repairing existing structures and facilities damaged by the Contractor's operations shall be at the Contractor's expense.

3.4 CLEANUP

A. Provide a clean and orderly site. Restore surrounding area to match existing.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.

B. Form accessories.

C. Form stripping.

1.2 SCOPE

A. Provide and install forms for all concrete, including but not limited to slabs-on-grade, foundations, retaining walls, elevated slabs, walls, mechanical and electrical items, such as cleanouts, valve access boxes and pads.

B. Install all bolts, anchors, sleeves, slots and inserts furnished under other sections, except that embedded items for mechanical items are to be installed by trade involved.

C. Coordinate with all trades to ensure proper placement of all items in forms and to provide proper blockouts wherever required.

D. Omission of Forms: Concrete foundations which are to permanently remain below grade may be formed against earth banks. Earth banks shall be sufficiently stable to maintain shape and width of footing shall be increased by 2". When this condition applies, form top edges to prevent sloughing of earth into footings.

1.3 RELATED REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcement.

B. Section 03 30 00 - Cast-In-Place Concrete.

C. Section 03 37 13 - Shotcrete.

D. Section 03 38 00 - Post-Tensioned Concrete.

E. Section 04 29 00 - Reinforced Unit Masonry.

F. Section 05 12 00 - Structural Steel Framing.

1.4 QUALITY ASSURANCE

A. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.

B. Use materials and products of one manufacturer whenever possible.

C. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Project Inspector. Work not so inspected is subject to uncovering and replacement.

1. Design, erect, support, brace and maintain formwork and shoring to safely support all vertical and lateral loads that might be applied until such loads can be carried by concrete.

2. Notify Inspector, Architect, Structural Engineer and DSA at least 48 hours prior to placing of concrete.

1.5 REFERENCE STANDARDS

A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

B. ACI 301 - Specifications for Structural Concrete; 2016.

C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).

D. ACI 347R - Guide to Formwork for Concrete; 2014, with Errata (2017).

E. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.

F. American Plywood Association (APA).

G. West Coast Lumberman's Association (WCLA).

H. PS 1 - Structural Plywood; 2009 (Revised 2019).

1.6 SUBMITTALS

A. See Division 1 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on materials including pre-manufactured forms, plywood form board, lumber for bracing and strongbacks, anchorage devices, form ties, chamfer and reveal strips, and form release agent. Provide data on void form materials and installation requirements.

C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, blockouts, locations of chamfer and reveal strips, locations of pour pockets, locations and methods for supporting other structural work, proposed construction joint locations, and arrangement of joints and ties.

1. Drawings are to be prepared by, signed and sealed by a Professional Engineer registered in the State of California.

D. Shoring Drawings: All shoring and re-shoring drawings are to be prepared by, signed and sealed by a Professional Engineer registered in the State of California.

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1.7 QUALITY ASSURANCE

A. Designer Qualifications: Design formwork and shoring under direct supervision of a Professional Engineer experienced in design of concrete formwork and shoring and licensed in California.

PART 2 - PRODUCTS

2.1 FORMWORK - GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.

C. Chamfer outside corners of beams, joists, columns, and walls, unless otherwise indicated on drawings.

D. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal of formwork.

E. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.

2.2 WOOD FORM MATERIALS

A. Form Materials: At the discretion of the Contractor.

2.3 PERMANENT FOAM FORMWORK

A. Expanded Polystyrene (EPS) or Extruded Polystyrene (XPS) Foam Board: ASTM C578, Type VII or Type XV.

1. Density: 2.85 lb/cu ft.

2. Compressive Resistance at 10% Deformation: 60 psi.

2.4 FORMWORK ACCESSORIES

A. Form Ties: Snap-off type, galvanized metal, fixed length, cone type, with waterproofing washer, 1-1/2 inch back break dimension, free of defects that could leave holes, fractures, spalls, or other surface defects larger than 1 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.

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3. VOC Content: In compliance with applicable local, State, and federal regulations.

C. Filler Strips for Chamfered Corners: Rigid Plastic or Wood Strip type; 3/4" X 3/4" inch size; maximum possible lengths.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

E. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 12 00.

F. Foam Tape: 1/8 inch thick adhesive backed closed cell PVC foam tape with tape width corresponding to edge thickness of plywood.

G. Waterstops: Preformed mineral colloid strips, 3/4 inch thick, moisture expanding.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 EARTH FORMS

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.3 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. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members that are not indicated on drawings.

F. Coordinate this section with other sections of work that require attachment of components to formwork.

G. Do not reuse formwork with patches or repairs that would result in adverse effects to exposed concrete.

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H. Verify that reinforcing steel has specified concrete cover over reinforcement and has been inspected prior to concealing with formwork.

3.4 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.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Locate and set in place items that will be cast directly into concrete.

B. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

C. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

D. Install waterstops where indicated on architectural drawings in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

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.

3.6 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.

3.7 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

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B. Construct permanent insulated foam panel formwork to maintain tolerances required by ACI 301.

3.8 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control inspection, as specified in Division 1.

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.

3.9 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads, no sooner than the following:

1. Bottom forms for mildly reinforced girders: 7 days and f'c=3,500 psi.
2. Side forms for girders: 3 days
3. Forms for columns and walls: 3 days **or f'c=3,500 psi. A reduced form removal time is acceptable upon review and approval of a formwork removal plan submittal prepared and stamped by a CA licensed shoring engineer.**
4. Forms for mat foundation: 2 days
5. Post tensioned slabs: 72 hours, f'c=3,500 psi and after post-tensioning.

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

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PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.

B. Reinforcing steel for shotcrete.

C. Reinforcing steel for masonry.

D. Supports and accessories for steel reinforcement.

1.2 RELATED REQUIREMENTS

A. Section 03 10 00 - Concrete Forms and Accessories.

B. Section 03 30 00 - Cast-In-Place Concrete.

C. Section 03 37 13 - Shotcrete.

D. Section 03 38 00 - Post-Tensioned Concrete.

E. Section 04 29 00 - Reinforced Unit Masonry.

1.3 REFERENCE STANDARDS

A. ACI 301 - Specifications for Structural Concrete; 2016.

B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).

C. ACI SP-66 - ACI Detailing Manual; 2004.

D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.

E. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2016.

F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.

G. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014 (Amended 2015).

H. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2018.

I. CRSI (DA4) - Manual of Standard Practice; 2009.

J. CRSI (P1) - Placing Reinforcing Bars; 2011.

1.4 SUBMITTALS

A. See Division 1 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar sizes and material types, lengths, spacings and locations, and quantities of reinforcing steel; bar schedules, stirrup spacing, shapes of bent bars, spacing of bars, and types and location of splices. Include special reinforcement required at openings and flat slab shear reinforcing.

1. Coordinate placement of embedded items with rebar placement.

2. Coordinate and indicate provisions for construction access.

3. Do not reproduce construction documents for shop drawings.

C. Manufacturer's Certificate: Submit to the special inspector certificates that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

E. Product Data: Submit for bar supports, chairs, rebar couplers, and flat slab shear reinforcing.

F. Reports: Submit to the special inspector certified copies of mill test report of reinforcement materials analysis.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Store reinforcement in a manner that will prevent rusting or coating with grease, oil, dirt, and other objectionable materials.

B. Deliver reinforcement to the job site bundled, tagged and marked, using metal tags.

1.6 QUALITY ASSURANCE

A. Perform work of this section in accordance with CRSI (DA4), CRSI (P1), ACI 301, ACI SP-66, and ACI 318 in addition to applicable building code.

1. Maintain one copy of each document on project site.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.4/D1.4M and no more than 12 months before start of scheduled welding work.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420) for #7 and smaller bars.

1. Deformed billet-steel bars.

2. Unfinished.

B. Reinforcing Steel: ASTM A 706/A 706M, Grade 60 (420) for #8 and larger bars and all bars to be welded. Permitted for bars #7 and smaller.

1. Deformed low-alloy steel bars

2. Unfinished.

C. High Strength Reinforcing Steel: ASTM A 706/A 706M, Grade 80, where noted on drawings.

1. Deformed low-alloy steel bars.

2. Unfinished.

D. Reinforcing Steel: Deformed bar anchors, ASTM A496, Grade 70.

E. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.

1. WWR Style: 4 x 8-W6 x W10.

2.2 REINFORCEMENT ACCESSORIES:

A. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

C. Bar Supports placed against ground: Precast concrete blocks not less than 3 inches square with embedded wires.

D. Mechanical Couplers: Type 2 per ACI-318 with current ICC or IAPMO evaluation report.

1. Manufacturers:

a. Headed Reinforcement Corporation (HRC); www.hrc-usa.com.

b. Erico; www.erico.com.

c. Dayton Superior; www.daytonsuperior.com.

d. Or approved equivalent.

E. T-Headed Reinforcement: In compliance with ACI 318, Section 12.6 and with current ICC or IAPMO evaluation report.

1. Manufacturers:

a. Headed Reinforcement Corporation (HRC); www.hrc-usa.com.

b. Erico; Product: www.erico.com.

c. Or approved equivalent.

F. Flat Slab Shear Reinforcement:

1. Manufacturers:

a. Decon USA, Inc.; Product: Studrails: www.studrails.com

b. Or approved equivalent.

2.3 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice, ACI SP-66 - ACI Detailing Manual, ACI 318, and ACI 301.

B. Mechanical couplers may be substituted for contact lap splices provided concrete cover and bar spacing requirements are met and when approved by SEOR.

C. Locate reinforcing splices not indicated on drawings at point of minimum stress.

1. Stagger splice locations so that no more than 50% of the bars are spliced at a section.

2. Locations of splices subject to approval by Architect.

2.4 SOURCE QUALITY CONTROL

A. An independent testing agency will perform source quality control review, as specified in Division 1.

B. Review mill test reports containing tensile and bend tests for type and grade of reinforcing steel.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position by more than the tolerances set forth in ACI 301.

B. Do not displace or damage vapor barrier or water proofing membrane.

C. Accommodate placement of formed openings.

D. Maintain concrete cover around reinforcing as indicated on drawings.

E. Clean reinforcement of loose rust and mill scale, oil, grease, earth, ice, cement splatter and other materials which reduce or prevent bond with concrete.

F. Set wire ties so ends are directed into concrete, away from concrete surfaces.

G. Welding:

1. Welding of crossing bars is not permitted.

H. Avoid bending or realigning reinforcement after being embedded in hardened concrete.

1. #6 and smaller bars accidentally bent may be realigned in field once.

a. If bent greater than 15 degrees, provide testing as required by the Field Quality Control section.

2. Obtain approval from SEOR for bar repairs.

3.2 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Division 1, will inspect installed reinforcement for conformance to contract documents before concrete placement.

B. Visually Inspect 100 percent of mechanical coupler installations.

C. Provide magnetic particle testing of reinforcing bars realigned or re-bent over 15 degrees.

D. Inspect placement, location, splices, spacing, size, cover and type of reinforcement for conformance with the contract documents.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Elevated concrete slabs.

B. Floors and slabs-on-grade.

C. Concrete foundations.

D. Concrete walls, columns and beams.

E. Concrete Drilled Piers.

F. Joint devices associated with concrete work.

G. Miscellaneous concrete elements, including equipment pads.

H. Concrete curing.

1.2 RELATED REQUIREMENTS

A. Section 03 10 00 - Concrete Forms and Accessories: Forms and accessories for formwork.

B. Section 03 20 00 - Concrete Reinforcement.

C. Section 03 35 00 - Decorative Concrete Finishing.

D. Section 07 95 13 - Expansion Joint Cover Assemblies.

E. Section 31 63 29 - Drilled Concrete Piers and Shafts.

1.3 REFERENCE STANDARDS

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

B. ACI 301 - Specifications for Structural Concrete; 2016.

C. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

E. ACI 304.2R - Placing Concrete by Pumping Methods; American Concrete Institute International;1996 (Reapproved 2008).

F. ACI 305R - Guide to Hot Weather Concreting; 2010.

G. ACI 306R - Guide to Cold Weather Concreting; 2016.

H. ACI 308R - Guide to External Curing of Concrete; 2016.

I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).

J. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.

K. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.

L. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2015.

M. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.

N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.

O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2020.

P. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2020b.

Q. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

R. ASTM C150/C150M - Standard Specification for Portland Cement; 2020.

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 C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 2020.

W. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.

X. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2019.

Y. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2017.

Z. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

AA. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2014.

AB. ASTM C 1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.

AC. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2017.

AD. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2020.

AE. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.

AF. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.

AG. ASTM E 329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing or Special Inspection.

AH. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2020.

AI. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers (Metric); 2014.

AJ. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

1.4 SUBMITTALS

A. See Division 1 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's data on manufactured products, curing material, slab treatments, evaporation reducing compound and joint fillers showing compliance with specified requirements.

1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.

C. Certified Mix Design: Submit for each type and strength of concrete, at least 4 weeks prior to placement in accordance with CBC Chapter 19A.

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. Include results of testing or test data used to establish mix proportions. This is to include unit weight, slump and tolerance, shrinkage, and compression test reports. Mix designs to be prepared, stamped and signed by a Professional Engineer registered in the State of California.

4. Submit certificates of compliance for materials of mix.

D. Test Reports: Submit report for each test or series of tests specified.

E. Coordination Drawings: Submit drawings showing size and location of all penetrations and embedded items in cast-in-place structural elements.

F. Construction Joint Layout: Submit drawings showing proposed construction joint locations.

G. Control Joint Layout: Submit drawings showing control joints locations in slab on grade.

H. Transit-Mix Delivery Slips

1. Keep a record at the job site showing time and place of each pour of concrete, together with transit-mix delivery slip certifying contents of the pour in accordance with the CBC Section 1705A.3.

2. Make all records available to the Architect and Division of the State Architect for their inspection upon request.

3. Upon completion of this portion of the work, deliver all records and the delivery slips to the Architect.

4. Batch Plant Certificates: Include with delivery of each load of concrete. Provide certificates to the Testing Agency and the Architect/Engineer as separate submittals. Concrete delivered to the site without such certificate shall be rejected and returned to the plant.

1.5 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. Manufacturer Qualifications:

1. A firm experienced in manufacturing ready mixed concrete products complying with ASTM C94/C94M and requirements for production facilities and equipment.

2. Manufacturer to be certified according to the National Ready Mixed Concrete Association certification for ready mixed concrete production facilities.

C. Placement and Finishing contractor to have a minimum of five years experience with similar types of projects.

D. Pre-Installation Meeting

1. Hold a pre-installation conference two weeks prior to the start of concrete pour at elevated concrete decks. Attendees shall include Contractor, Architect, Structural Engineer, and Project Inspector.

2. Review Contractor's intended method of pour, including lines and levels, and Architect's expectations related to floor flatness, inspection, self-leveling concrete floor underlayment, installation of casework and other related topics.

PART 2 - PRODUCTS

2.1 FORMWORK

A. Comply with requirements of Section 03 10 00.

2.2 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 03 20 00.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type I - Normal or Type II - Moderate Portland type.

1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C 33 and as modified below.

1. Coarse Aggregates: Cleanness Value of not less than 75 as tested per California Test Method 227.

2. Fine Aggregates: Sand Equivalent of not less than 75 as tested per California Test Method 217.

3. Acquire all aggregates for entire project from same source.

C. Fly Ash: ASTM C618, Class F, 25% max, and per CBC Section 1903A.6.

D. Raw or Calcined Natural Pozzolan: ASTM C618, Class N, 25% max per CBC Section 1903A.6.

E. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1. 10% max per CBC Section 1903A.6.

F. Ground Granulated Blast-Furnace Slag: ASTM C989. 50% max per CBC Section 1903A.6.

G. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.

1. Color(s): To match Architect's sample(s) when incorporated into specified mix design(s).

H. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.4 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Admixtures to be compatible with all other components in the mix.

C. Admixtures are to be included in the mix used to establish the mix design.

D. Air Entrainment Admixture: ASTM C260/C260M and CBC Section 1904A.1.

1. Not acceptable for use in concrete mixes for interior floor slabs that will not be subject to freeze-thaw cycles.

E. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

F. Water Reducing Admixture: ASTM C494/C494M Type A.

G. Shrinkage Reducing Admixture:

1. ASTM C494/C494M, Type S.

2. Manufacturers:

a. Grace Construction Products; Eclipse 4500: www.na.graceconstruction.com.

b. Substitutions: See Section 01 60 00 - Product Requirements.

2.5 ACCESSORY MATERIALS

A. Underslab Vapor Barrier: Multi-layer plastic extrusion or equivalent, complying with ASTM E 1745, Class A, 0.38mm (15mil) or greater; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single ply polyethylene is prohibited.

1. Permeance: 0.01 perms [grains/(ft2 x hr x inHg)] maximum as tested in accordance with ASTM E 1745 Section 7. Provide independent testing data showing compliance.

2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.

3. Manufacturers:

a. Fortifiber Building Systems Group: www.fortifiber.com/#sle.

b. Stego Industries, LLC: www.stegoindustries.com/#sle.

B. 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. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch.
3. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.

C. Architectural Concrete Floor Topping:

1. Compressive Strength: Minimum 4000 pounds per square inch, tested per ASTM C472.

2.6 BONDING AND JOINTING PRODUCTS

A. Waterstops: Bentonite and butyl rubber.

1. Configuration: As indicated on drawings.
2. Size: As indicated on drawings.
3. Products:
   a. CETCO, a division of Minerals Technologies Inc; WATERSTOP RX: www.mineralstech.com/#sle.

2.7 CURING MATERIALS

A. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.

B. Moisture-Retaining Sheet: ASTM C171.

1. Curing paper, regular.
2. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch.
3. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.

C. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, clear.

D. Water: Potable, not detrimental to concrete.

2.8 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with CBC Chapter 19A and ACI 211.1 recommendations.

1. Use admixtures as necessary to produce concrete of a consistency that will allow thorough compaction of the concrete into corners and around reinforcing without excessive puddling, spading or vibration, and without permitting the materials to segregate or free water to collect on the surface. Produce dense and uniform concrete free from rock pockets, honeycomb and other irregularities.

2. Contractor to review and approve the proposed concrete mix designs for compatibility with placing requirements to ensure that the concrete as designed can be placed in accordance with the Drawings and Specifications.

B. 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. Mix design to be prepared by a licensed Professional Engineer.

1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Cements and aggregates to have a proven history of successful use together. Alternatively submit evidence satisfactory to Architect that aggregate will not react harmfully in presence of alkalis in cement.

E. Normal Weight Concrete:

1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.

2. Cement Replacement Requirements: Conform to CBC Section 1903A.6 and ACI 318 Table 26.4.2.2(b).

3. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.

4. Ground Granulated Blast-Furnace Slag: Maximum 50 percent of cementitious materials by weight.

5. Calcined Pozzolan Content: Maximum 25 percent of cementitious materials by weight.

6. Silica Fume Content: Maximum 10 percent of cementitious materials by weight.

7. Water-Cement Ratio: Maximum 45 percent by weight.

8. Dry Unit Weight: Minimum 144 lbs per cubic foot and maximum of 150 lbs per cubic foot.

9. Total Air Content: 3 percent maximum at point of placement, determined in accordance with ASTM C173/C173M.

10. Maximum Slump: 8 inches.

11. Maximum Aggregate Size: 1 inch.

12. Drying Shrinkage: Test per ASTM C192 and ASTM C157, measured at 28 days air dry age.

a. Typical: Maximum 0.050 percent unless otherwise indicated.

b. Suspended Slabs: Maximum 0.045 percent.

c. Slabs-on-Grade: Maximum 0.040 percent.

d. Shrinkage Reducing Admixture: Provide as required to attain maximum drying shrinkage when adequate shrinkage data for concrete mix design is not available.

F. Concrete Exposure Classes: All concrete to be exposure class F0, S0, W0 and C0 per ACI 318 unless otherwise noted. Concrete mixtures to additionally comply with ACI 318 tables 19.3.2.1 and 19.3.3.1.

G. Patching Mortar: Mix in proportions by volume of one-part cement to two parts water. Substitute white cement for part of cement as necessary to produce color matching surrounding concrete.

2.9 MIXING

A. Conform to requirements of CBC Chapter 19A and ACI 211.5R-14.

B. Concrete shall be Ready-Mix Concrete: Mix and deliver in accordance with the requirements set forth in ASTM C 94 and ACI 301. Continuous Batch Plant inspection may be waived in accordance with CBC Section 1705A.3.3, with approval by Structural Engineer of Record, approval by DSA, and the following:

1. Approved Testing Laboratory shall check the first batching for each class of concrete and furnish mix proportions to the Licensed Weighmaster.

2. Licensed Weighmaster to positively identify materials as to quantity and to certify to each load by ticket.

3. Ticket shall be transmitted to Project Inspector by truck driver with load identified thereon. Project Inspector will not accept load without load ticket identifying mix and will keep daily record of pours, identifying each truck, its load and time of receipt and will transmit two copies of record to DSA.

4. Do not add water at the site to concrete mixes with a maximum specified WCR unless the water content at batch time provides for a WCR less than specified and this provision, including the quantity of water which may be added at the site, is specifically noted on the Mix Design and Certification by the mix preparer.

5. At end of project, Weighmaster shall furnish affidavit to DSA on form satisfactory to DSA, certifying that all concrete furnished conforms in every particular and to proportions established by mix designs.

C. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

1. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.

D. Transit Mixers: Comply with ASTM C94/C94M.

E. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

2.10 SOURCE QUALITY CONTROL

A. An independent testing agency will perform source quality control review, as specified in Division 1.

B. Review mix designs and certificates of compliance for materials Contractor proposes to use.

PART 3 - EXECUTION

3.1 APPROVAL OF FORMS AND REINFORCEMENTS

A. Forms and reinforcements are subject to approval by the Project Inspector, and notice of readiness to place first pour shall be given to DSA, Architect and Structural Engineer 48 hours prior to placement of concrete.

3.2 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.3 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. Protect finished surfaces adjacent to concrete placement.

D. Roughen surfaces of previously placed and existing concrete to 1/4 inch amplitude by heavy sand-blasting, waterblasting and/or bush-hammering. Prior to receiving concrete, clean surfaces of dust and debris using compressed air or water.

E. Clean surfaces of reinforcement and forms previously coated with cementitious materials by wire brushing or other acceptable means.

F. Thoroughly wet all concrete and wood forms before application of concrete. Do not allow free water to remain on the surface.

G. Install vapor barrier under interior slabs-on-grade. Lap joints minimum 6 inches and in accordance with manufacturer instructions. Seal watertight by taping edges and ends as required by manufacturer.

3.4 PLACING CONCRETE

A. Place concrete in accordance with ACI 301 and ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Notify Architect not less than 48 hours prior to commencement of placement operations.

D. Do not place concrete until testing agency has inspected reinforcing placement.

E. Water may be added once to each truckload in the field provided the mix design water-cement ratio is not exceeded.

F. Ensure reinforcement, inserts, embedded parts, and formwork and subgrade will not be disturbed during concrete placement.

G. Place concrete continuously without construction (cold) joints wherever possible.

H. Consolidate concrete in accordance with ACI 309R.

I. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.5 SLAB JOINTING

A. Locate joints as indicated on the drawings and as required in this section.

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 concrete at point of placement, set flush with top of slab.

D. Saw Cut Control (Contraction) Joints in Slabs-on-Grade: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 1/8 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab as indicated on the drawings. Locate control joints a maximum of 30 times the slab thickness in each direction. Limit the ratio of control joint spacing for each direction to 1.25.

3.6 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 01 40 00, will inspect finished slabs for compliance with specified tolerances.

B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:

1. Exposed to View and Foot Traffic: F(F) of 35; F(L) of 25 Slabs-on-grade and shored slabs.

2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15 Slabs-on-grade and shored slabs.

3. Under Carpeting: F(F) of 25; F(L) of 20 Slabs-on-grade and shored slabs.

5. Under Thin Resilient Flooring: F(F) of 35; F(L) of 25 Slabs-on-grade and shored slabs.

C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.

D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

E. Correct defects by grinding, floating with leveling compound, or by removal and replacement of the defective work. Areas requiring corrective work to be identified by Contractor. Re-measure corrected areas by the same process.

3.7 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Wall Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish per architectural finish plans:

1. Painted concrete wall (C2), Class B formwork with CSC 2 finish.
2. Architecturally exposed concrete wall (C3), Class B formwork, CSC 2 finish, and sack finish.

D. Concrete Beams, Girders, and Columns: Smooth formed, Class B formwork, CSC 2 finish.

E. Concealed Concrete Surfaces: Rough Formed

F. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows, unless otherwise noted on architectural drawings:

1. Surfaces to Receive Thin Floor Coverings: "Light Steel-trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, and fluid applied waterproofing.
2. Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
    a. Chemical Hardener: After slab has cured, apply water-diluted hardener in three coats per manufacturer's instructions.
3. For air-entrained concrete, do not densify surface by hard steel troweling operations.

G. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.

3.8 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

1. Normal concrete: Not less than seven days.

C. Formed Surfaces: Cure by moist curing with forms in place. Provide curing for remainder of curing period after form removal.

D. Surfaces Not in Contact with Forms:

1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.

2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist until finishing is completed by water-fog spray or evaporation reducers or retarders.

3. Final Curing: Begin after initial curing but before surface is dry by one of the following:

a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.

b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

A. Inspection: There will be initial or preliminary inspection of the finished concrete slabs by the Project Inspector and/or Architect for flatness. If deemed necessary, the Owner reserves the right to have a survey performed by a registered surveyor or testing lab. If it is determined that floors not meeting the flatness criteria is due to means and methods fully within the control of the Contractor, the cost of the survey will be back charged to the Contractor. This includes, but is not limited to the erection of steel and metal deck outside industry tolerances and referenced standards.

B. Concrete Strength Testing: Comply with CBC Section 1705A.3, 1903A, 1904A, and as specified in this Section. Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports

1. Four identical cylinder samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, or not less than once for each 50 cubic yards of concrete, or not less than once for each 2,000 square feet of surface area for slabs or walls. In addition, samples for strength tests for each class of concrete shall be taken for seven-day tests at the beginning of the concrete work or whenever the mix or aggregate is changed.

2. Strength tests will be conducted by the Testing Lab on one cylinder at seven (7) days and two cylinders at twenty-eight (28) days. The fourth remaining cylinder will be available for testing at fifty-six (56) days if the 28-day cylinder test results do not meet the required design strength.

3. On a given project, if the total volume of concrete is such that the frequency of testing required in Paragraph A.1 above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.

4. Cost of retests and coring due to low strength or defective concrete will be paid by School District and back-charged to the Contractor.

C. Moisture and PH Testing of Concrete Slab-On-Grade and Above-Grade Concrete, Scheduled to Receive Floor Finish Material: Refer to Section 09 05 12, Concrete Floor Moisture Content and pH Testing.

D. An independent testing agency will perform field quality control tests, as specified in Division 1.

E. Provide free access to concrete operations at project site and cooperate with appointed firm.

F. Provide full time special inspection during concrete placement and proposed remediation.

G. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

H. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

I. Concrete Temperature: Test hourly when air temperature is 40F (4C) and below, and when 80F (27C) and above; and each time a set of compression test specimens is made.

J. Review the ticket of each batch of concrete delivered to the site for conformance with this specification.

K. Verify proper curing procedure and applications at initial curing and final curing stages.

L. Verify within 72 hours after placement that floor tolerances are within the limits specified herein.

3.10 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 complying with required lines, details, dimensions, tolerances or specified requirements.

C. Where deficiencies are noted, the testing agency or Contractor to report defective concrete in writing to Architect and Contractor within 24 hours.

D. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing, repair and design services to be borne by Contractor when defective concrete is identified.

E. Contractor to submit repair of defective concrete within 2 days of discovery.

F. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place architectural concrete, including form facings, reinforcement accessories, concrete materials, concrete mixtures, concrete placement, and concrete finishes.
2. Requirements in Section 033000 "Cast-in-Place Concrete" apply to this Section.

1.2 DEFINITIONS.

A. Aggregate Exposure: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

B. Cast-in-Place Architectural Concrete: Concrete that is exposed to view, is designated as architectural concrete, and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance. At all exposed concrete shearwalls and columns, interior and exterior.

C. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

D. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

E. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at 2118 Milvia Street, Berkeley, CA. 94704.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Form-facing panels.
2. Form joint tape.
3. Form joint sealant.
4. Wood sealer.

5. Form-release agent.
6. Surface retarder.
7. Form ties.
8. Bar supports.
9. Portland cement.
10. Fly ash.
11. Slag cement.
12. Blended hydraulic cement.
13. Aggregates.
14. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.
11. Alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Formwork: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

D. Samples: For each of the following materials:

1. Form-facing panels.
2. Form ties.
3. Form liners, 12-by-12-inch Sample, indicating texture.
4. Exposed aggregates.
5. Chamfers and rustications.

E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Curing process.

F. Placement Schedule: Submit before start of placement operations.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.

B. Material Test Reports: For the following, by a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Aggregates[**:** Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity].

C. Research Reports: For concrete admixtures in accordance with ICC AC198.

D. Preconstruction Test Reports: For each mix design.

E. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Installer Qualifications: An experienced cast-in-place architectural concrete installer, as evidenced by not less than five consecutive years' experience, specializing in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1. Provide written evidence of qualifications and experience.

2. Include locations, descriptions, and photographs of completed projects, including name of architect, substantiating the quality of the installer's experience.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 FORM-FACING MATERIALS

A. Comply with Section 031000 "Concrete Forming and Accessories" for formwork and other form-facing material requirements, and as specified in this Section.

B. Form-Facing Panels for As-Cast Finishes:

1. Steel- and glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
2. Exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, high-density overlay, Class 1, or better complying with DOC PS 1[, or Finnish phenolic overlaid birch plywood].

C. Rustication Strips: Metal[**,** dressed wood**,** or rigid plastic, with sides beveled and back kerfed; nonstaining; in longest practicable lengths.

D. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch , minimum; nonstaining; in longest practicable lengths.

E. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch thick.

F. Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or Type S, Grade NS, that adheres to form joint substrates, does not stain, does not adversely affect concrete surfaces, and does not impair subsequent treatments and finishes of concrete surfaces.

G. Wood Sealer: Penetrating, clear, polyurethane wood sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood and does not stain, does not adversely affect concrete surfaces, and does not impair subsequent treatments and finishes of concrete surfaces.

H. Form-Release Agent: Commercially formulated, colorless form-release agent that does not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments and finishes of architectural concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Surface Retarder: Water-soluble chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed architectural concrete surface to depth of aggregate exposure specified.

1. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch and not more than 1 inch (25 mm) in diameter, of color [to match Architect's sample] [selected by Architect from manufacturer's full range].

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place.

1. Manufacture bar supports in accordance with CRSI's "Manual of Standard Practice."
2. Where legs of wire bar supports contact forms, use gray, all-plastic] CRSI Class 1, gray, plastic-protected bar supports.

3. Maximum Coarse-Aggregate Size: 3/4 inch
4. Gradation: Uniformly graded.

B. Normal-Weight Fine Aggregate: ASTM C33/C33M manufactured or natural sand, free of materials with deleterious reactivity to alkali in cement, from same source for entire Project.

C. Air-Entraining Admixture: As specified in Section 033000 "Cast-in-Place Concrete."

D. Chemical Admixtures: As specified in Section 033000 "Cast-in-Place Concrete," and certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

E. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and requirements of paragraph 5.4.

2.4 CURING MATERIALS

A. Comply with Section 0330000 "Cast-in-Place Concrete."

2.5 CONCRETE MIXTURES, GENERAL

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
4. Total of Fly Ash or Other Pozzolans: 35 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.

B. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
   1. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with Section 031000 "Concrete Forming and Accessories" for formwork, embedded items, and shoring and reshoring, and as specified in this Section.

B. Limit deflection of form-facing panels to not exceed ACI 301 requirements.

C. Limit cast-in-place architectural concrete surface irregularities, as follows:
   1. Surface Finish-3.0: ACI 117 Class A, 1/8 inch .

D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117.

E. Seal form joints, chamfers, rustication joints, and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.

   1. Provide closure backing materials if indented rustication is used over a ribbed form line, and seal joint between rustication strip and form with joint sealant.

F. Chamfer exterior corners and edges of cast-in-place architectural concrete.

G. Coat contact surfaces of wood rustications and chamfer strips with wood sealer before placing reinforcement, anchoring devices, and embedded items.

H. Coat contact surfaces of forms with form-release agent, in accordance with manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.

I. Coat contact surfaces of forms with surface retarder, in accordance with manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.

3.2 CONCRETE PLACEMENT

A. Comply with Section 03 30 00 Cast-in-Place Concrete.

3.3 FINISHING FORMED SURFACES

A. Comply with Section 03 30 00 Cast-in-Place Concrete.

B. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.

C. As-Cast Surface Finishes: Comply with Section 03 30 00 Cast-in-Place Concrete for the following:

1. ACI 301 (ACI 301M) Surface Finish-3.0 (SF-3.0.)

D. Final Concrete Finish: Comply with Section 033000 "Cast-in-Place Concrete."

3.4 CONCRETE CURING

A. Comply with Section 03 30 00 Cast-in-Place Concrete using identical curing procedures to that used for field sample panels.

3.5 REPAIR

A. Comply with ACI 301 (ACI 301M).

B. Repair damaged finished surfaces of cast-in-place architectural concrete when repairing is approved by Architect.

C. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved field sample panels.

D. Remove and replace cast-in-place architectural concrete that cannot be repaired to Architect's approval.

3.6 FIELD QUALITY CONTROL

A. Comply with Section 033000 "Cast-in-Place Concrete."

3.7 CLEANING

A. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

B. Wash and rinse surfaces in accordance with concrete finish applicator's written instructions.

1. Protect other Work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

3.8 PROTECTION

A. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

B. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

3.9 FINAL ACCEPTANCE

A. Final acceptance of completed architectural concrete Work will be determined by Architect by comparing approved field sample panels with installed Work, when viewed at a distance of 20 feet

END OF SECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Included: Concrete polishing, complete, as shown and specified.

B. Other Applicable Sections: Following Sections apply to Work under this Section.

1. Section 03 10 00 Concrete Formwork.

2. Section 03 20 00 Concrete Reinforcement.

3. Section 03 30 00 Cast-In-Place Concrete.

1.3 REFERENCES

A. General: Comply with the applicable provisions of the referenced standards except as modified by governing codes and the Contract Documents. Where a recommendation occurs in the referenced standards, it shall be considered mandatory. In the event of conflict, the more stringent standard or requirement shall govern.

1. American Concrete Institute (ACI):

a. ACI 301 “Specifications for Structural Concrete for Buildings”.

b. 302.1R “Recommend Practice for Concrete Floor and Slab Construction”.

2. American Society for Testing and Materials (ASTM)

a. ASTM D2047 “Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine”.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements

1. Slip Resistance, Wet Dynamic Coefficient of Friction (DCoF): Wet DCoF of installed flooring and paving shall be as follows, when measured in accordance with NFSI/ANSI B101.3.

a. Level Surfaces: Not less than 0.42.

1.5 SUBMITTALS

A. Product Data: Submit for Architect's action. Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating specified requirements. Include technical data sheet giving descriptive data, curing time, and application requirements.

B. Samples:

1. Provide polished and semi-polished samples for Architect's initial review and selection. Samples to be at least 12 in. square and will be returned to subcontractor. Selected sample will be kept for project record.

C. Quality Assurance/Quality Control Submittals: Submit for Architect's information.

1. Certificates:

a. Document Review: Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents, shop drawings and product data have been reviewed with qualified manufacturer representatives. The statement shall certify that selected materials are proper, compatible with contiguous materials and adequate for the application shown.

b. Installer's Qualifications

1.6 QUALITY ASSURANCE

A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

B. Walkway Auditor: Certified by NFSI as a "Walkway Auditor Certificate Holder."

C. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.

D. Mock−Up(s):

1. Visual: Prepare a visual mock-up of the polished concrete, extent as shown. Or, if not shown, extent shall be at least 16 ft. by 16 ft. Notify Architect when mock-up is available for review. Do not proceed with work until Architect has approved the visual mock-up.

E. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, Architect's consultants, Contractor, and subcontractors whose work is relevant to this Specification Section.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's instructions. Concrete shall be cured a minimum of 28 days.

B. Application shall take place at least 10 days prior to racking and other in-store accessory installation providing a complete, uninhibited concrete slab for application.

C. Power Supply: Provide generator to supply required 480V, 3 phase, 50 amp power required to operate equipment.

PART 2 – PRODUCTS

2.1 POLISHED CONCRETE MATERIALS

A. Polished Concrete: Provide polished concrete floor system "Ultraflor Diamatic USA" or equal. Flooring system shall be NFSI certified and meet specified performance requirements. At areas noted as C-1 on finish plans. Semi-polished finish.

B. Aggregate for Concrete Mix: Coarse aggregate. See Section 03 30 00, 2.2 B.

C. Integral Color: Provide pricing for add alternate to include integrally colored concrete.

D. Densifier: QuestMark 7923 DiamondGuard II concrete Densifier hardening/sealing agent, or approved equal.

E. Sealer Coat: As recommended by Installer.

F. Water: Potable.

G. Epoxy Filler: QuestMark 3380 100% Solids Epoxy Liquid, or approved equal.

H. Joint Sealant: Two-component sealant.
1. Products: QuestMark 5830 Fast Set Flexible Joint Sealant, or approved equal. Color: Clear.

PART 3 – EXECUTION

3.1 SURFACE CONDITIONS

A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.

B. Verify that base slabs meet finish and surface profile requirements in Division 3 section “Cast-in-Place Concrete” and Project Conditions above.

C. Prior to application, verify that floor surfaces are free of construction laitance.

3.2 APPLICATION OF SEALED CONCRETE

A. General: Apply concrete sealer in accordance with manufacturer’s recommendations.

B. Apply two coats of concrete sealer, unless otherwise directed by Architect.

3.3 APPLICATION OF POLISHED CONCRETE

A. LEVEL 2 CUT / A slightly deeper cut the exposes the fine aggregates and begins to expose the coarse aggregates. Also referred to as a salt and pepper finish.

B. Specified polished floor details

a. Specified floor finish shall have a cut Level of 2
b. Specified floor finish shall have a gloss Level of B – Medium gloss reading of 41-55. 800 grit diamond finish.
c. Specified Flor-Color shall be TBD
d. See addendum for specific steps

1. GRIND/POLISH #1: DIAMATIC 60/80 Grit Metal Bonded Diamonds.
2. Broom and vacuum the floor to remove all residual dust.
3. GRIND/POLISH #2: DIAMATIC #1 Transitional Diamonds, Ceramic Bonded.
4. Broom and vacuum the floor to remove all residual dust.
5. GRIND/POLISH #3: DIAMATIC 200 Grit Resin Bonded Diamonds.
6. Broom and vacuum the floor to remove all residual dust.
7. Apply DIAMATIC FLOR-SIL™ per application instructions at a rate of 400 square feet per gallon.
8. Allow DIAMATIC FLOR-SIL™ to dry 1 hour before continuing on to the next step.
9. GRIND/POLISH #4: DIAMATIC 400 Grit Resin Bonded Diamonds.
10. Broom and vacuum the floor to remove all residual dust.
11. GRIND/POLISH #5: DIAMATIC 800 Grit Resin Bonded Diamonds.
12. Broom and vacuum the floor to remove all residual dust.

13. MICROPOLISH/BURNISH #1: FLOR-GRIT 800 Diamond Impregnated Pad.
14. Dry mop the floor clean to remove all debris.
15. Apply DIAMATIC FLOR-FINISH (High Gloss) per application instructions at a rate of 2,500- 3,000 square feet per gallon.
16. Allow to dry a minimum of 15-30 minutes.
17. MICROPOLISH/BURNISH #2: FLOR-GRIT 800 Diamond Impregnated Pad.
18. Dry mop the floor clean to remove all debris.
19. Apply DIAMATIC FLOR-FINISH (High Gloss) per application instructions at a rate of 3,000 square feet per gallon, 90 degrees to the first application.
20. Allow to dry a minimum of 15 minutes.
21. MICROPOLISH/BURNISH #3: FLOR-GRIT 1500 Diamond Impregnated Pad.

3.4 JOINT SEALANT

A. Install sealant in all construction, isolation, and control joints in exposed slabs, in accordance with manufacturer's recommendations. Coordinate timing of installation with floor polishing operations.

B. Allow slab to cure to the maximum extent possible before installing joint sealant, but not less than two months.

C. Remove all loose material from joints by wire brushing.

D. Provide backer material to provide joint depth to width ratio, and minimum depth required by sealant manufacturer.

E. Install sealants so that sealants completely fill recess and provide uniform, cross-sectional shapes and depths relative to joint widths.

F. Allow three day sealant cure time before foot traffic and one week before full service use.

3.5 WORKMANSHIP AND CLEANING

A. The premises shall be kept clean and free of debris.

B. Remove spatter from adjoining surfaces.

C. Repair damages to surface caused by cleaning operations.

3.6 QUALITY CONTROL

A. Contractor shall hire a Walkway Auditor to test entirety of the polished concrete floor. Floor auditing shall be conducted in accordance with NFIS/ANSI B101.3.

Where concrete floor does not meet specified performance requirements, Contractor shall provide remediation, at no additional cost, that is acceptable to the Owner and Architect.

3.7 PROTECTION

A. Protect finished work until fully cured in accordance with manufacturer's recommendations.

B. Use Ramboard, or equal floor covering/protection immediately following polishing and maintain through substantial project completion.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pneumatically applied concrete.

1.2 RELATED REQUIREMENTS

A. Section 03 10 00 - Concrete Forms and Accessories.

B. Section 03 20 00 - Concrete Reinforcement.

C. Section 03 30 00 - Cast-In-Place Concrete.

D. Section 05 05 23 - Adhesive and Mechanical Fasteners: Mechanical items for casting into shotcrete.

1.3 REFERENCE STANDARDS

A. ACI 301 - Specifications for Structural Concrete for Buildings: American Concrete Institute International; 1999.

B. ACI 506R - Guide to Shotcrete; American Concrete Institute International; 2016.

C. ACI 506.2 - Specification for Shotcrete; 2013.

D. ACI CCS-4(20) - Shotcrete for the Craftsman, American Concrete Institute; 2020.

E. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.

F. ASTM C 42/C 42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete; 2003.

G. ASTM C150/C150M - Standard Specification for Portland Cement; 2020.

H. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

I. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.

J. ASTM C 1141- Standard Specification for Admixtures for Shotcrete; 2015

K. ASTM C1604/1604M - Standard Test Method for Obtaining and Testing Drilled Cores of Shotcrete; 2005(2012).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

B. The term "Nozzle Operator" in this section is to include any building code or referenced standard reference to "Nozzleman".

1.5 SUBMITTALS

A. See Division 1 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data on admixtures and curing compounds.

C. Shop Drawings: Indicate formwork, and dimensions, thickness, and tolerances, reinforcement, inserts, accessories. Shop drawings to include mockups and test panels.

D. Placement schedule: Indicate schedule of placement and location of construction joints.

E. Certified mix design: Submit for each type and strength of shotcrete, at least 4 weeks prior to placement of wall test panels.

1. Include results of testing or test data used to establish mix proportions. This is to include weight, slump, shrinkage, and compression test reports. Mix designs to be prepared, stamped and signed by a Professional Engineer registered in the State of California.

F. Submit certificates of compliance for materials of mix.

G. Nozzle Operator Qualifications: Submit for each nozzle operator performing shotcrete operations.

1. ACI Certification

2. Documentation of experience.

3. Project specific mock-up wall test panel grading.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 506.2, except as modified herein.

1. Maintain one copy of document on site.

B. Applicator Qualifications: Company specializing in performing shotcrete installations, with minimum five years of documented experience.

C. Nozzle Operator Qualifications: Certified by ACI, and having over 3,000 hours of experience as a nozzle operator, and at least three similar project applications in past 5 years.

1.7 MOCK-UP

A. Wall Test Panel: Construct vertical wall test panels, 6 feet tall by 6 feet wide by 18 inch thick.

B. Wall Test Panels: A minimum of four weeks prior to starting shotcrete work, construct mock-up for evaluation of proposed materials, equipment and workmanship:

1. Provide one test panel fabricated by placing shotcrete onto plywood for each mix design being considered, for each shooting position to be encountered, for each proposed nozzle operator, and a minimum of 3 total test panels.

a. Prepare panels using anticipated shooting orientation and distance from application.

2. Form and reinforce panels to replicate the most congested wall on the project. Include bar bends, reinforcing couplers, reinforcing splices, foundation and wall dowels, additional vertical column bars and ties, and other perimeter conditions.

3. Finish each panel with finish to be used on the project.

4. Form panels to identical shotcrete thickness with reinforcement in place.

C. Locate mock-ups where directed.

D. Mock-ups may not remain as part of the Work.

1.8 FIELD CONDITIONS

A. Maintain material and surrounding air temperature at minimum 50 degrees F prior to and during installation and maintain material at this minimum temperature for 7 days after completion of work. Provide equipment and cover to maintain minimum temperature.

B. Suspend shotcrete operations during high winds, rainy weather, or near freezing temperatures when work cannot be protected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal; gray color.

B. Aggregate: Normal weight, ASTM C 33, ¾" maximum. For shear walls, shotcrete shall conform to course aggregate grading No. 2 per Table 1.1 of ACI 506.

C. Admixtures: Chemical type conforming to ASTM C494/C494M and ASTM C1141 (wet mix only).

D. Air-Entraining Admixture: Complying with ASTM C260/C260M (wet mix only).

E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to shotcrete.

F. Curing Compound: ASTM C309, Water-based, spray-on, penetrating curing compound and hardener; not detrimental to application of subsequent surface finish materials; containing no wax, resin, or solvents.

G. Alignment Wire: Small gauge, high strength steel wire.

2.2 SHOTCRETE MIX

A. Provide wet mix design that gives good compaction and low percentage of rebound, is stiff enough not to sag.

B. Comply with following requirements:

1. Compressive Strength (28 day minimum): As indicated on drawings

2. Aggregate Size (maximum): 1/2 inch. Coarse aggregate Grading No. 2 per Table 1.1 of ACI 506R.

3. Pozzolanic Mineral Admixture: 25 percent maximum of total cementitious material by mass.

4. Slump: 1 1/2 inch to 3 inch.

C. Maintain quality control records during production of shotcrete; make records available.

2.3 EQUIPMENT

A. Mixing Equipment: Capable of thoroughly mixing aggregate, cement, and water in sufficient quantity to maintain continuous placement.

B. Delivery Equipment: Capable of discharging wet mix aggregate, cement, and water accurately, uniformly, and continuously.

2.4 SOURCE QUALITY CONTROL AND TESTS

A. An independent testing agency will provide inspection and testing services, as specified in Division I.

B. Prior to start of work, testing agency will review mix proportions, gradation, and quality of aggregate.

C. Provide inspection for compliance with design mix.

D. Test samples in accordance with ACI 506.2, except as modified herein.

E. Independent testing agency will test mock-up wall test panels as follows:

1. Core six test specimens from each panel in accordance with ASTM C42 at following locations in panel:
    a. Three non-reinforced locations.
    b. Three reinforced locations, each taken at different congested areas.
    c. In lieu of coring, the test specimens may be sawcut.
2. Test the non-reinforced specimens for compliance with the specified physical properties in accordance with ASTM C42.
3. Visually grade the reinforced specimens for compliance with specified core grade in accordance with ACI 506.2.
    a. Mean Core Grade: Less than or equal to 2.5.
        1) Only nozzle operators meeting this grade will be approved to place shotcrete.
        2) Additional cores may be taken from panel to increase sample size.
        3) A second set of test panels may be shot and tested.

F. Modify mix design as required based on results of testing and inspection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that conditions are acceptable and are ready to receive work.

C. Verify that field measurements are as indicated on drawings.

D. Verify fabricated forms are:
1. True to line and dimension.
2. Adequately braced against vibration during placement.
3. Constructed to permit escape of trapped air during gunning operations.
4. Constructed to minimize rebound during gunning operations.

E. Verify correct placement of reinforcement with sufficient clearances to permit complete encasement.

F. Verify that embedded fittings, pipe, conduits, and other items are correctly and securely placed.

G. Ensure easy access to shotcrete surfaces for screeding and finishing, and to permit uninterrupted application.

3.2 PREPARATION

A. Remove existing unsound material from substrate surfaces.

1. Minimize abrupt changes in depth of area to be repaired.

2. Remove square external corners from substrate by radiusing the edges.

B. Determine operating procedures for placement in close quarters, extended distances, or around unusual obstructions where placement velocities and mix consistency may be adjusted during application.

C. Clean and wet cementitious or absorptive substrate surfaces prior to receiving shotcrete. Keep porous surfaces damp for several hours prior to placement of shotcrete.

D. Protect adjacent surfaces not receiving shotcrete, including, but not limited to, finishes, pipes and utility lines.

E. Provide additional sacrificial reinforcing for structural soundness test cores as noted on drawings. Clearly document location for future test cores.

3.3 ALIGNMENT CONTROL

A. Provide alignment wire to establish thickness and plane of required surfaces.

B. Install alignment wire at corners and offsets not established by forms.

C. Tighten alignment wire true to line. Position adjustment devices to permit additional tightening.

3.4 APPLICATION

A. Place shotcrete in accordance with ACI 506.2.

B. Use mixing and delivery equipment capable of thoroughly mixing aggregate, cement, and water in sufficient quantity to maintain continuous and uniform placement.

C. Do not apply shotcrete more than 90 minutes after batching.

D. Do not place shotcrete on surfaces that are frozen, spongy, or where there is free water.

E. Achieve maximum compaction with minimum rebound.

F. Build-up to required thickness in multiple passes to achieve single layer. Encase reinforcement adjacent to form with the first pass.

G. Construction Joints: Provide where unfinished work stands for more than 30 minutes.

1. Construction joints to be sloped at a 45-degree angle.

2. Unless otherwise indicated, square construction joints are not permitted.

H. Do not permit applied shotcrete to sag, slough, or displace.

I. After initial set of final layer, remove excess material outside of forms and alignment lines.

J. At existing floors, do not pneumatically apply the shotcrete. Turn off the air, place, and mechanically vibrate the shotcrete mix.

K. Sandblast construction joints to remove laitance and roughen joint. Clean with air/water pressure jet. Wet entire surface prior to application of additional shotcrete.

L. Finish surface of final layer with wood float finish.

M. Remove rebound at construction joints and reinforcing steel extending from joint.

N. Remove rebound material that does not fall clear of work; discard salvaged rebound.

O. Maintain shotcrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of shotcrete, minimum 24 hours per CBC 1908A.9.1.

P. Immediately after placement, protect shotcrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

Q. Apply curing compound to exposed surfaces according to manufacturer's instructions.
1. Apply at 200 percent of manufacturer's minimum required application rate.

R. Sound test the applied material with hammer for voids. Expose voids and submit repair procedure for review and approval.

3.5 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Division 1.

B. Provide continuous special inspection during shotcrete placement. Verify materials, placing equipment, details of construction, preparation of base materials and construction procedures.

C. Material Test Panels: Perform in accordance with the California Building Code, latest edition, Chapter 19.

1. Prepare 18 inch by 18 inch by 5 1/2 inch minimum test panels for each days work, or each shift whichever is less, and for every 50 cubic yards of concrete placed.

a. Panels to be prepared in the same position as the work, during the course of the work and by the nozzle operators performing the work.

2. Obtain three, 3-inch diameter by 5 1/2" long concrete core specimens from each test panel prepared in accordance with ASTM C1604, no sooner than 7 days after preparing the panel.
    a. Test cylinders are not to be prepared by shooting directly into a cylinder.
    b. Specimens are to be water soaked for a minimum of 24 hours prior to testing.
3. Perform standard compression tests on each group of core specimens for each panel and verify compliance with specified physical properties using the referenced Code requirements.

D. Structural Soundness Test Cores: Perform in accordance with the California Building Code, latest edition, Chapter 17A.

1. Obtain three 3-inch concrete core specimens from three areas chosen by the Engineer of Record that contain additional sacrificial rebar.
2. Perform visual examination of cores for reinforcing bar embedment, voids, rock pockets, sand streaks and similar deficiencies.
3. Submit report to enforcement agency prior to final approval of the shotcrete.

3.6 PROTECTION

A. Do not permit applied work to damage adjacent surfaces.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section includes all materials, labor, services and equip-ment necessary to complete all post-tensioning work on the structure as shown on the Drawings and specified herein: including shop drawings, post-tensioning tendon specifications, post-tensioning tendons, anchorages, distribution plates, spacer bars, systems, layouts of tendon loca-tions, placing of tendons, stressing tendons (jacking, anchoring and cutting off excessive lengths), records of all elongations, gauge readings, pump calibration and protection of tendon hardware after stressing. All post-tensioning work shall be performed by a quali-fied post-tensioning installer approved by the En-gineer.

B. Related work specified in other sections:

1. Section 03 10 00: Concrete Formwork.
2. Section 03 20 00: Concrete Reinforcement.
3. Section 03 30 00: Cast-in-Place Concrete.

1.2 APPLICABLE SPECIFICATIONS AND CODES

A. Building Code Requirements for reinforced concrete (ACI 318).

B. Specifications for Structural Concrete for Buildings (ACI 301).

C. Recommendations for Concrete Members Prestressed with Unbonded Tendons (ACI 423.3R).

D. Specifications for Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete - ASTM A 416.

E. Specification for Unbonded Single Strand Tendons (PTI M10.2-00).

F. Specification for Unbonded Single Strand Tendon (ACI 423.7).

G. Some products and execution are specified in this section by reference to published specifications or standards of the following.

1. American Concrete Institute (ACI);
2. The American Society of Testing and Materials (ASTM);
3. Prestressed Concrete Institute (PCI);
4. Post-tensioning Institute (PTI).

1.3 SUBMITTAL

A. Manufacturer's Literature: Submit manufacturer's standard specifications, test data and installation instructions for each product edited to correlate to specific job requirements.

B. Shop Drawings: The Contractor shall submit one sepia plus one print of Shop Drawings to the Engineer for review. The following information shall be provided on the shop drawings.

1. Submittals shall be in compliance with the General Conditions.
2. Tendon layout dimensions locating tendons in horizontal plane at all points. Show all openings in slabs and beams as required.
3. Provide tendon profiles showing chair heights and locations. Show clearly the method and location of each tendon support.
4. Furnish details of reinforcement around stressing pockets and closures, if any, of where interference with post-tensioned tendons may occur.
5. Show spacing of anchors to meet criteria of paragraph 2.1.B.3a.
6. Show required elongation of each tendon at jacking points.
7. Contractor shall include the calculations of friction losses on the Shop Drawings to determine that design forces are obtainable. Fur-nish the calculations or the test results as to the adequacy of anchorage.
8. After completion of the review process, the Shop Drawings and data shall not be changed nor shall construction operations be deviated from, unless such changes are approved in writing.
9. Engineer's review of details and construction operations shall be for general conformance with Contract Documents and will not relieve the Contractor of his responsibility for completing the work success-fully in accordance with these specifications and within the contract time.
10. Provide calculations signed and sealed by Professional Engineer registered in State of California.

C. Methods: Furnish complete prestressing procedure to include the following:

1. Jacking force and jacking pressure.
2. Maximum temporary jacking force and jacking pressure.
3. Certified jack calibrations and the method of jack identification. (Use of non-calibrated jack and pump will not be allowed on the job).
4. Method of determining slack, if any.
5. Method of determining anchor force, or force remaining in tendons after anchor.
6. Staging of stress operation when such staging is necessary.
7. Furnish method of burning off excess tendon after anchorage.

8. Provide method for sealing tendons and/or tendon anchorage pock-ets.

D. Tests:

1. The costs of testing specified in this Section shall be paid for by the Owner.

2. Samples for testing shall be accompanied by the Vendor's certifica-tion that samples are representative of material to be furnished, and submitted to the Contractor and to the Structural Engineer.

3. Two tests shall be made for each reel, heat or lot number being used on the job and shall be recorded for identification purposes. Prestressing steel shall be tested for tensile strength and elongation at rupture. Each size of strand to be shipped to the site shall be as-signed an individual lot number and shall be tagged accordingly. The modulus of elasticity shall be determined for each reel, heat or lot number.

4. If adequate information concerning the suitability of prestressing sys-tem cannot be furnished to the Engineer, the Engineer may require tests to be made of the system. The contractor shall bear all the costs of these tests.

E. Mill test reports:

1. Certified mill test reports shall be furnished upon request for each coil or pack of strand, containing as a minimum the following test in-formation:

a. Heat number and identification;

b. Standard chemical analysis for heat of steel;

c. Ultimate tensile strength;

d. Yield strength at 1% extension under load;

e. Elongation at failure;

f. Modulus of elasticity;

g. Diameter and net area of the strand;

h. Type of material (stress-relieved or low relaxation).

1.4 VERIFYING CONDITIONS

A. Visit the site, verify all conditions and dimensions. Examine all drawings af-fecting the work of this Section.

B. Check all work or surfaces to receive work of this Section. Report all condi-tions, which interfere with or will prevent proper execution of the work of this Section.

1.5 COORDINATION WITH OTHER SECTIONS

A. Coordinate all work with that of other Sections. All trades shall be given full cooperation and access for the installation of inserts, bolts, and other em-bedded items in the Concrete.

B. The following criteria for coordination will be followed:

1. Power driven or post-installed anchors for securing steel studs, etc., shall not be allowed at areas where the tendon approaches either the top or bottom surfaces of the slabs.

2. Conduit may be embedded in post-tensioning slabs when meeting the following conditions.

a. Space conduits minimum 1-1/2 diameters clear but no less than 1-1/2" clear. Where conduits are highly congested, conduit installer shall submit details of proposed installation for review and approval.

b. Conduits shall be supported on accessories supplied by con-duit installer. In no case shall conduits rest on, displace, or tie to tendons.

c. Conduit diameter shall not exceed 25% of slab thickness, and shall be placed within the middle one-third of slab thick-ness.

3. Sleeves and cast inserts shall be used in lieu of coring and post-installed anchors. Length of continuous inserts shall not exceed 2'-0" unless specifically coordinated with tendon Shop Drawings and reviewed by the Engineer.

1.6 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. For the work of this Section, use a subcontractor having a successful record of completing work of the type specified, to the approval of the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pre-stressing Steel: Lolax strands used in single strand unbonded post-tensioning tendons shall conform to ASTM A 416 Grade 270, specifications for Uncoated Seven-Wire Low Relaxation Type strands for Prestressed Concrete".

1. Strands shall have the following properties:

a. Nominal Diameter = 1/2 inch

b. = 0.153 sq. in.

c. Modulus of Elasticity = 28,000 psi

d. Ultimate Strength = 270,000 psi

2. Strands shall be encapsulated in accordance with the requirements of Section 2.2.6 of PTI M10 and per Section 2.5 of ACI 423.7-07.

3. Strand not specifically itemized in ASTM A 416 may be used provided it conforms to the minimum requirements of this specifica-tion and has no properties which make it less satisfactory than those listed in ASTM A 416.

4. Relaxation losses for low relaxation type material shall be based on relaxation tests of representative samples for a period of 1000 hours, when at 70 degrees F and stressed initially to not less than 70 per-cent of the minimum guaranteed breaking strength of the strand. The tests shall be in accordance with ASTM A 416 and ASTM E 328.

5. Low relaxation strand shall be provided with a mill applied continuous permanent physical marking to permit field identification.

6. The material shall be packaged at the source in a manner which prevents physical damage to the strand during transportation and protects the material from deleterious corrosion during transit and storage.

7. Broken strands and strands showing fabrication defects shall be removed and replaced or member may be rejected.

8. All prestressing steel, within every group of the same type of mem-bers, shall be of same heat where practicable. All the steel shall be assigned a heat number and tagged accordingly.

B. Anchorage: Anchorage devices shall meet the minimum requirements set forth in the ACI 318, "Building Code Requirements for Reinforced Concrete", latest edition and the following criteria:

1. The anchorages of unbonded tendons shall develop at least 95 per-cent of actual ultimate strength of the prestressing steel without ex-ceeding anticipated set. The actual strength of the prestressing steel shall not be less than specified by the applicable ASTM Standard, and shall be determined by tests of representative samples of the tendon material in conformance with ASTM Standards. The total elongation under ultimate load of the tendon shall not be less than 2 percent measured in a minimum length of 10 ft.

2. Tendon anchorages and couplings shall be designed to develop the static and dynamic strength requirements listed below:

   a. Static Tests - The test assembly shall consist of standard production quality components and the tendons shall be at least 10 ft. long. The test assembly shall be tested in a man-ner to allow accurate determination of the yield strength, ultimate strength and percent elongation of the complete tendon to ensure compliance with this specification. The specimen used for the static test need not be one that has been subjected to dynamic loading.

   b. Dynamic Tests - Dynamic tests shall be performed on repre-sentative tendon specimens. In the first test, the tendon shall withstand, without failure, 500,000 cycles from 60 percent to 66 percent of its minimum specified ultimate strength. In the second test, the tendon shall withstand, without failure, 50 cycles from 40 percent to 80 percent of its minimum specified ultimate strength. The period of each cycle involves the change from the lower stress level to the upper stress level and back to the lower.

The specimen used for the second dynamic test need not be the same used for the first dynamic test. Systems utilizing multiple strands, wires or bars may be tested utilizing a test tendon. The test tendon shall duplicate the behavior of the full size tendon and generally shall not have less than 10 percent of the capacity of the full size tendon. Dynamic tests are not required on bonded tendons, unless the anchorage is located or used in such manner that repeated load applications can be expected on the anchorage.

c. The average compressive concrete bearing stress of anchorages shall not exceed the limits set forth below:

1) At service load:

$$f_{cp} = 0.6\, f'_c \sqrt{\frac{A'_b}{A_b}}$$

2) but not greater than 1.25 f'c

3) At transfer load:

$$f_{cp} = 0.8\, f'_{ci} \sqrt{\frac{A'_b}{A_b} - 0.2}$$

4) but not greater than 1.25 f'ci.

5) Where:

(a) = permissible compressive concrete stress;

(b) = compressive strength of concrete;

(c) = compressive strength of concrete at time of initial prestress;

(d) = maximum area of the portion of the concrete anchorage surface that is geometrically similar to and concentric with the area of the anchorage;

(e) = bearing area of the anchorage.

6) As used in the above equation f'c is the average bearing stress, P/A, in the concrete computed by dividing the force P of the prestressing steel by the net projected area, Ab, be-tween the concrete and the bearing plate or other structural element of the anchorage which has the function of transfer-ring the force to the concrete.

7) Special reinforcement, required for the performance of the anchorage, shall be indicated by the tendon supplier.

8) Bending stresses in the bearing plates and anchors shall not exceed 27,000 psi for ASTM A36 structural steel and 20,000 psi for ASTM C148 cast steel. For higher strength steel, corresponding high

stresses may be permitted upon the approval of the structural engineer.

9) These bearing stresses must be appropriately reduced as required, where tendons are in congested areas and in areas depreciated by openings, depressions or other architectural, mechanical or structural details.

10) For wedge type anchorages, the wedge grippers shall be designed to preclude premature failure of the prestressing steel due to notch or pitching effects under the static and/or dynamic test load conditions stipulated for both stress relieved and low relaxation prestressing steel materials.

11) Anchorages are intended for use in corrosive environments and shall include design features permitting a watertight connection of the sheathing to the anchorage, and watertight closing of the wedge cavity, for stressing and non-stressing (fixed) anchorages. Inter-mediate stressing anchorages shall be designed to permit complete watertight encapsulation of the prestressing steel.

C. Corrosion Preventive Coating:

1. The corrosion preventive coating material shall have the following properties:
   a. Provide corrosion protection to the prestressing steel,
   b. Provide lubrication between the strand and the sheathing;
   c. Resist flow from the sheathing within the anticipated tem-perature range of exposure;
   d. Provide a continuous non-brittle film at the lowest anticipated temperature of exposure;
   e. Chemically stable and non-reactive with the prestressing steel, the sheathing material and the concrete.
2. The film shall be an organic coating with appropriate polar, moisture displacing and corrosion preventive additives.
3. Minimum weight of coating material on the prestressing strand shall be not less than 2.5 pounds of coating material per 100 feet of 0.5 inch diameter strand, and 3.0 pounds of coating material per 100 feet of 0.6 inch diameter strand. The amount of coating material used shall be to ensure essentially complete filling the annular space between the strand and the sheathing. The coating shall extend over the entire tendon length.
4. Test results in accordance with the Table I, Page 03365-11 shall be provided for the corrosion preventive coating material:

D. Sheathing:

1. The tendon sheathing for unbonded single strand tendons shall be made of a material with the following properties:

a. Sufficient strength to withstand unrepairable damage during fabrication, transport, installation, concrete placement and tensioning;

b. Watertightness over the entire sheathing length;

c. Chemical stability, without embrittlement or softening over the anticipated exposure temperature range and the service life of the structure;

d. Non-reactive with concrete, steel and the tendon corrosion preventive coating.

2. Minimum thickness of the sheathing shall not be less than 0. 040 inches for medium or high density polyethylene or polypropylene.

3. The sheathing shall have an inside diameter at least 0.010 inches greater than the maximum diameter of the strand.

4. For applications in corrosive environments, the sheathing shall be connected to all stressing, intermediate and fixed anchorages in a watertight fashion, thus providing a complete encapsulation of the prestressing steel.

TABLE 1 PERFORMANCE SPECIFICATION FOR CORROSION PREVENTIVE COATING

TEST	**TEST METHOD**	**ACCEPTABLE CRITERIA**
1. DROPPING POINT DEG. F (DEG. C)	ASTM D 566 OR ASTM D 2265	MINIMUM 300 (148.9)
2. OIL SEPARATION@ 160 DEG. F (71.1 DEG. C) % BY WEIGHT	FTMS 791B METHOD 321.2	MAXIMUM 0.5
3. WATER, % MAX.	ASTM D 95	0.1
4. FLASH POINT, DEG. F (DEG. C) (REFERS TO OIL COMPONENT)	ASTM D 92	MINIMUM 300 (148.9)
5. CORROSION TEST ENVIRONMENTS: RUST5% SALT FOG @ 100 DEG. F (37.8 DEG. C)	ASTM B 117	FOR NORMAL-GRADE 7 OR BETTER AFTER 720 HOURS OF EXPOSURE ACCORDING TO ASTM D610. FOR CORROSIVE ENVIRONMENTS: RUST GRADE 7 OR BETTER AFTER 1000 HOURS OF EXPOSURE ACCORDING TO ASTM D 610. (1)
6. WATER SOLUBLE IONS (2) A. CHLORIDES B. NITRATES C. SULFIDES	 ASTM D 512 ASTM D 992 APHA 427D (15 TH. ED.)	 10 PPM MAX 10 PPM MAX. 10 PPM MAX.

7. SOAK TEST 5% SALT FOG AT 100 DEG. F. (37.8 DEG. C) 5 MILS COATING, Q PANELS, TYPE S. IMMERSE PANELS 50% IN A 5% SALT SOLUTION AND EXPOSE TO SALT FOG.	ASTM B 117 (MODIFIED)	NO EMULSIFICATION OF THE COATING AFTER 720 HOURS EXPOSURE.
8. COMPATIBILITY WITH SHEATHING A. HARDNESS AND VOLUME CHANGE OF POLYMER AFTER EXPOSURE TO GREASE, 40 DAYS @150 DEG. F. B. TENSILE STRENGTH CHANGE OF POLYMER AFTER EXPOSURE TO GREASE, 40 DAYS @ 150 DEG. F.	ASTM D 4289 ASTM D 638	PERMISSIBLE CHANGE IN HARDNESS 15% PERMISSIBLE CHANGE IN VOLUME 10% PERMISSIBLE CHANGE IN TENSILE STRENGTH 30%
NOTES: EXTENSION OF EXPOSURE TIME TO 1000 HOURS FOR GREASES USED IN CORROSIVE ENVIRONMENTS REQUIRES USE OF MORE OR BETTER CORROSION INHIBITING ADDITIVES. PROCEDURE: THE INSIDE (BOTTOM AND SIDES) OF A 1L PYREX BEAKER, APPROXIMATE O.D. 105 MM, HEIGHT 145 MM, IS THOROUGHLY COATED WITH 100 +/- 10 G OF CORROSION PREVENTIVE COATING MATERIAL. THE COATED BEAKER IS FILLED WITH APPROXIMATELY 900 CC OF DISTILLED WATER AND HEATED IN AN OVEN AT A CONTROLLED TEMPERATURE OF 100 DEG. F +/- 2 DEG. F FOR 4 HOURS. THE WATER EXTRACTION IS TESTED BY THE NOTED TEST PROCEDURES FOR THE APPROPRIATE WATER SOLUBLE IONS. RESULTS ARE REPORTED AS PPM IN THE EXTRACTED WATER.		

E. Coupling:

1. Couplings of unbonded tendons shall be used only at locations specifically indicated and approved by the Engineer. Couplings shall not be at points of sharp tendon curvature.

2. All couplings shall develop at least 95% of the minimum specified ul-timate strength of the prestressing tendon without exceeding the an-ticipated set.

3. The couplings of tendons shall not release the elongation at rupture below the requirements of the tendon itself.

4. Couplings shall be coated with the same corrosion preventative coat-ing used on the strand and shall be enclosed in sleeves which permit necessary movements during stressing.

F. Ultimate Strength: The ultimate strength of unloaded tendons shall be taken greater than the ultimate capacity of the anchorages or couplings.

G. Accessories: Accessories required for placement and alignment of the ten-dons shall conform to the concrete reinforcement section of these Specifica-tions.

2.2 OTHER MATERIALS

A. 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 Engineer.

B. Non-Shrink, Non-Metallic Grout: The non-shrink grout shall be a factory pre-mixed grout and shall conform to ASTM C1107, “Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).” In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under a 4’ x 4’ base plate. Provide one of the following:

1. “NS Grout”, by The Euclid Chemical Co.
2. “NC Grout”, by Tamms Industries

C. Where high fluidity and/or increased placing time is required using the specified high flow grout, provide one of the following:

1. “Hi-flow Grout”, by The Euclid Chemical Co.
2. “Tammsgrout Supreme”, by Tamms Industries

PART 3 - EXECUTION

3.1 FABRICATION

A. Tendons:

1. Strand tendons shall consist of the required number of 1/2" parallel lay, uncoated, stress relieved, seven wire strand. Strand shall be cut to length allowing sufficient length for attachment of stressing equip-ment. A minimum length of twelve inches at each stressing end is required. Tendons shall be furnished in continuous length, without splices, and enclosed in suitable slippage sheathing ready for im-mediate placement in the forms. Tendons shall be coiled and suffi-ciently tied to prevent premature uncoiling.
2. Strand tendons shall be cut to length at fabricating plant, tagged for identification, and coiled for delivery and shipment to jobsite. Tags shall show the location of the tendon in the forms in conformance with the shop drawings.

B. Couplings of unbonded tendons shall be used only at locations specifically indicated and/or approved by the Engineer. Couplings shall not be used at points of sharp tendon curvature. All coupling components shall be com-pletely protected with coating materials prior to final encasement in concrete.

C. Anchorage components shall be protected with coating material prior to final encasement in concrete.

D. Tendons shall be manufactured in such sequence and quantity as to avoid lengthy storage at the jobsite.

E. Pre-stressing steel shall be satisfactorily protected from excessive rust or other corrosion prior to placement. Sufficient protection shall also be provided for exposed pre-stressing steel at the end of the tendon.

F. Substitutions of post-tensioning system or changes in tendon size and spacing will be considered only on written approval by the Engineer and Construction Manager. The submissions for approval shall include calculations and fabrication and placement drawings.

3.2 SURFACE CONDITIONS

A. The post-tensioning supplier must examine the conditions under which the post-tensioning work is to be performed and notify the contractor in writing of any unsatisfactory conditions. Do not proceed with the work until the unsatisfactory conditions have been corrected in an acceptable manner and approved.

B. The post-tensioning supplier shall provide on-site supervision as required to instruct in the use of stressing equipment and placement of anchorage devices.

3.3 PLACING

A. Placing of the post-tensioning tendons shall be performed by experienced personnel that have been thoroughly instructed and trained in the proper post-tensioning procedures.

B. End anchorages:

1. End anchorages shall be securely fastened to the end forms and shall be perpendicular to the longitudinal axis of the tendon. End anchorages shall be located at the center of gravity axis of the mem-ber unless otherwise shown. Curvature in the tendon profile shall not occur closer than 3 feet from the stressing anchorage.

2. Stressing anchorages shall be attached to the bulkhead forms by either bolts, nails or threaded pocket former fittings. The connections shall be sufficiently rigid to avoid accidental loosening due to con-struction traffic or during concrete placement. Minimum concrete cover for the anchorage shall not be less than the minimum cover to the reinforcement at other locations in the structure.

3. Pocket formers used to provide a void form at stressing and intermediate stressing anchorages shall be positively precluded intrusion of concrete or cement paste into the wedge cavity during concrete placement. The depth of the pocket former from the edge of the concrete to the face of the anchorage shall not be less than 2 inches.

C. Intermediate anchorages:

1. Intermediate anchorages may be installed either embedded in concrete or bearing against the hardened concrete at the construction joint. In the latter case, the anchorage shall have a flat bearing side and the concrete bearing area shall be smooth and without ridges.

2. When placing intermediate anchorages against already hardened concrete, special attention shall be paid to the perpendicularity between the bulkhead form and tendon during placement. This type of anchorage is not recommended for use in corrosive environments.

3. Minimum cover requirements of this Section of these Specifications apply to intermediate anchorages.

D. Fixed anchorages:

1. Fixed end anchorages shall be installed on the tendon at the supplier's plant prior to shipment to the job site.

2. For wedge type anchorages, the fixed end wedges shall be seated, with a load not more than 80% of the minimum ultimate tensile strength of the tendon for stress relieved strand or for low relaxation strand. The seating load shall be sufficient to ensure adequate capacity of non-stressing anchorages.

3. Fixed end anchorages shall be placed in the formwork at the loca-tions shown on the placing drawings, and securely fastened to the reinforcing steel.

4. Minimum cover requirements of this Section of these Specifications apply to fixed end anchorages.

5. Fixed end anchorages intended for use in corrosive environments shall be closed or capped at the wedge cavity side with a watertight cover. This cover shall be shop installed, after filling the void around the wedge grips with corrosion preventative coating material comparable to that used as a corrosion preventive coating over the length of the tendon.

E. Supports for tendons shall be such as to insure their remaining in proper position during the placing of the concrete. Unless otherwise indicated, supports for tendons shall be located at high and low points of profile and at control points located at each 1/4 span of each span or as needed. The use of screws to attach supports for formwork will not be allowed.

F. Vertical tendon dimensional tolerance shall not vary from the dimensions shown on the contract drawings and the approved tendon profile drawings by more than 1/8 of an inch. The maximum horizontal departure from a straight line shall not exceed 1/4" in 12'-0" or be less than a radius of curvature of 21'-0". The clear spacing between tendons shall not be less than one and one-half (1-1/2) the maximum aggregate size except as shown on the Drawings where bundled strands are required. Tendons shall follow an approximate parabolic curvature between the low points and the high points of each span.

G. Tendon supports shall be furnished by strand installer and shall be as detailed unless otherwise permitted. Supports shall be located at the 1/4 points of each span, or as needed and shall be adequately tied to prevent movement or dislodgment during concrete placement. Tendons shall be securely tied to each support to prevent dislodging during concrete place-ment.

H. The minimum clear concrete coverage for tendons shall not be less than 1-1/2 inches for top cover and 3/4 inch for bottom cover, and shall be in ac-cordance with the latest revision of the ACI Building Code, the Prestressed Concrete Institute's "Standard Recommendations for Prestressed Concrete", or the Post-tensioning Institute's "Post-tensioning Manual".

I. Tendons shall be maintained in a straight line, laterally, between anchorages and shall be tied at the intersections where they contact the tendons in the perpendicular direction by standard tie of #16 black annealed tie-wire.

J. Tendons may be displaced as shown on the typical details laterally to miss openings in the slab, as long as this occurs no more than twice on any single tendon, and as long as the angular offset does not exceed 1 in 12. If a greater displacement is required, anchor plates shall be shifted so that the tendon misses the opening, at the direction of the Engineer.

K. Where tendons seem to interfere with each other, one tendon may be moved horizontally in order to avoid this interference. Where there is interference between tendons and any kind of conduit, the tendon profile governs.

L. Placement of mild steel reinforcement shall be coordinated with placement of post-tensioning tendons. Proper tendon placement has priority.

M. Tendons shall clear openings and drains by 2-1/2 inches.

N. Sheathing inspection:

1. After installing the tendons in the forms and prior to concrete placing, the sheathing shall be inspected for possible damage.

2. In corrosive environments, damaged areas shall be repaired by restoring the corrosion preventive coating in the damaged area and repair-ng the sheathing. Repairs to sheathing shall be watertight and must be approved by the Engineer.

3. Tape used to repair sheathing shall be adhesive moisture proof tape, spirally wrapped around the tendon to provide at least two layers of tape.

O. Safety precautions shall be taken to prevent workers from standing behind, above or in front of the stressing jacks during the stressing operations.

P. When welding or burning near post-tensioning tendons or anchorages, care should be taken to prevent tendon components from overheating, and to prevent molten slag from coming into contact with tendons. Care should be exercised to prevent torch flame from coming into contact with wedge grip-pers. No arc welding to be done near tendons.

Q. Upon completion of the stressing operation the tendons shall be finished in accordance with the following procedure:

1. Immediately after tendon tensioning and satisfactory check of elongation and approval of elongation records by the Owner's independent consultant and/or testing agency, the excess tendon length shall be cut. The tendon length protruding beyond the wedges after cutting shall be between 3/4 and 1-1/4 inches.

    a. Tendons shall be cut by means of either cutting, abrasive wheel or hydraulic shears.

2. Stressing pockets shall be cleaned and filled with non-metallic, non-shrink grout as soon as practical after tendon stressing and cutting. Under no circumstances shall the grout or mortar used for pocket filling contain chlorides or other chemicals known to be deleterious to the prestressing steel.

3. The exposed strand and wedge areas shall be coated with tendon coating material comparable to that used over the length of the ten-don and a watertight cap shall be applied over the coated area.

4. Prior to installing the pocket grout, the inside concrete surfaces of the pocket shall be coated or sprayed with a resin bonding agent.

3.4 CONCRETE PLACEMENT

A. Concrete placement shall conform to Section 3C of these Specifications.

3.5 STRESSING

A. Stressing of the post-tensioning tendons shall be performed under the su-pervision of experienced personnel who have been thoroughly instructed and trained in the use of the stressing equipment.

B. Records of elongation and anchor of each tendon shall be kept by the con-tractor and shall be submitted to the Engineer promptly upon the completion of the post-tensioning of each slab. Keep records of final elongation ob-tained for each tendon. Record gauge pressure at anchor liftoff for each 12th tendon or as directed by the structural engineer.

1. Stressing records shall contain the following information:

    a. Tendon mark or identification;

    b. Required elongation;

    c. Gauge pressure to achieve required elongation;

    d. Actual elongation achieved;

    e. Actual gauge pressure;

    f. Date of stressing operation;

    g. Signature of the stressing operator or inspector;

h. Serial or identification number of jacking equipment.

2. Stressing records shall be turned over to the Engineer for verification and safekeeping.

C. Tensioning operation shall not begin until tests of the concrete cylinders, manufactured and cured under the same conditions as the members to be stressed, indicated that the concrete in the members has attained a compres-sive strength of not less than the larger of 40% of the 28 days specified strength or as otherwise specified on the contract drawings or 3,000 psi. A minimum of two cylinders shall be tested. The lowest test results shall not be more than 10% below the specified strength and the average strength of the two tests shall not be less than that specified.

D. After tests indicate that the concrete has reached sufficient strength, the tendons shall be stressed by means of hydraulic jacks equipped with calibrated pressure gauges with an accuracy of 1% of the scale range against known standards at intervals not exceeding 6 months, to permit the stress in the prestressing steel to be computed at any time. Certified test gauge calibration data shall accompany each test gauge. The stressing operation shall be conducted in a safe manner and as recommended by the manufacturer of the prestressing materials.

E. Stress transfer on strand tendons shall be such as to prevent undue scraping of the strand by the wedge grippers during seating.

F. Wedge grippers on strand tendons shall be properly aligned before and after stressing to ensure proper stress retention and to prevent notching of the strand more severely than the normal anchoring wedges.

G. The cause of any difference between the calculated and measured elongation which exceeds 5% shall be ascertained and corrected.

H. The prestressing steel shall be anchored at an initial anchor force or stress that will result in the ultimate retention of the working or effective force shown on the plans. The maximum effective stress shall not exceed 60 percent of the ultimate stress. In no case may the steel be tensioned above 80% (41.3 X .80 = 33.0 kips) of the specified ultimate strength of the prestressing steel. The anchor force shall not exceed 70% (41.3 X .70 = 28.9 kips) of the specified ulti-mate strength of the prestressing steel. Anchor forces shall be verified when necessary by lift-off readings.

I. Jacking from each end of the tendons shall be required when, in the opinion of the Structural Engineer, there is excessive friction between the prestress-ing steel and enclosures. Proper allowance shall be made in any case for friction losses and one tendon shall be checked for friction losses at the start of the post-tensioning.

J. No tensioning will be permitted until it is demonstrated that prestressing steel is reasonably free and unbonded in the enclosure. Evidence that the steel is unbonded will be considered satisfactory if inward movement of the steel is observed at one end of the tendon when a nominal pull is applied to steel at the other end, or when an auxiliary mild steel wire placed in the enclosure for the full length of the enclosure can be pulled intact from the enclosure. An agreement not exceeding five percent between

the observed and the expected elongation after prestressing will be considered satisfactory evidence.

K. End bearing forces shall be uniformly distributed or an end block properly designed, and reinforcement for induced stresses shall be provided.

L. After stressing is completed and only with prior approval from the Engineer, tendons shall be cut or burned off as specified previously in this Section.

M. Exposed stressing recess shall be filled flush with a mix of epoxy, cement, sand and water. White cement shall be added as required for the filler to match adjacent concrete when finished. This work shall be performed as soon as practical after stressing by the contractor.

N. All pockets and closure strips required for anchorages shall be adequately reinforced so as not to decrease the strength of the structure.

3.6 QUALITY CONTROL IN THE FIELD

A. The Owner shall provide inspections through its independent consultant and/or testing agency which shall include the following:

1. Inspection of tendon placement and supporting devices. Contractor shall not be allowed to place concrete until reinforcing steel has been inspected and approved.

B. The Owner's independent consultant and/or testing agency will monitor the tendons force and elongation, before and after anchoring, and certification of jacks.

C. The Owner's independent consultant and/or testing agency are hired solely for the protection of the Owner and does not relieve the Contractor of his responsibility to provide tendons in accordance with Drawings and Specifications.

D. Notify the independent consultant or testing agency and the Architect when all tendons and reinforcement are in place for each pour, at least 24 hours in advance of placing concrete.

E. Exposed tendons in finished work, indicating that the bars are not properly located will be sufficient cause for rejection, removal and replacement of the concrete section.

F. Corrections shall be made by the Contractor at his expense.

G. Cost of testing and inspecting required under this Section will be paid for by the Owner, except for mill tests and certificates described in this section.

H. Cooperate with the owner's testing and inspecting agency and/or personnel as required to enable fulfillment of its duties.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete block.

B. Mortar and grout.

C. Reinforcement and anchorage.

D. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcement: Reinforcing steel for grouted masonry.

1.3 REFERENCE STANDARDS

A. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM A 563 - Standard Specification for Carbon and Alloy Steel Nuts; 2000.

D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.

E. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2020.

F. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2020a.

G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

H. ASTM C150/C150M - Standard Specification for Portland Cement; 2020.

I. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

J. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.

K. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.

L. ASTM C476 - Standard Specification for Grout for Masonry; 2020.

M. ASTM C387 - Packaged, Dry, Combined Materials, for Mortar and Concrete.

N. ASTM C426 - Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

O. ASTM C911 - Quicklime for Structural Purposes.

P. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

Q. ASTM F 844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use; 2004e1.

1.4 SUBMITTALS

A. See Division 1 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for masonry units, mortar and grout, and joint materials.

C. Shop Drawings: Indicate bar sizes, spacings, reinforcement quantities, bending and cutting schedules, reinforcement supporting and spacing devices, accessories and control joint locations. Do not reproduce contract documents for shop drawings.

D. Design Data: Indicate required mortar strength, unit assembly strength in each plane, and supporting test data used to establish masonry strength. Submit mix designs for mortar and grout, stamped and signed by a registered Professional Engineer in the State of California. Mix design and test results for all mortar and grout shall conform to the requirements herein and TMS 602-15 Article 1.5.

1. Establish masonry assembly strength using one of the following methods:

a. Unit Strength Method: In accordance with current California Building Code Section 2105.2.2.1.

b. Prism Test Method: In accordance with current California Building Code Section 2105.2.2.2.

E. Manufacturer's Certificate: Certify that masonry units, cement, aggregates, lime and admixtures meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of the contract documents.

1. Maintain one copy of each document on project site.

B. Special Inspection: Coordinate with Owner's special inspector of building structural masonry construction in compliance with 2019 CBC Section 1705A.4. See Section 04300, Article 1.09 for additional requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Protect cementitious materials against exposure to moisture. Use of cementitious or other materials that have become caked and hardened from absorption of moisture will not be permitted.

1.7 FIELD CONDITIONS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:

1. Size: Standard units with nominal face dimensions of 16 x 8 inches unless otherwise noted on drawings, and nominal depths as indicated on the drawings for specific locations.

2. Special Shapes: Provide non-standard blocks configured for other detailed conditions.

3. Load-Bearing Units: ASTM C90, medium weight.

a. Hollow block, as indicated.

b. Compressive Strength: As required to establish strength of masonry block assembly, 2000 psi min

c. Exposed Faces: Manufacturer's standard color and texture where indicated.

d. Pattern: Per architectural drawings.

4. Strength of Masonry Block Assembly: F'm= 2,000 psi, or as indicated on drawings.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Aggregate: ASTM C144.

D. Grout Aggregate: ASTM C404.

E. Admixtures: Use only with Architect's approval and not adversely affecting bond or compressive strength.

F. Air-Entraining Admixture: Not permitted.

2.3 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: Type specified in Section 03 20 00; size as indicated on drawings; uncoated finish.

B. Headed Anchor Rod: ASTM F1554, Grade 36.

C. Threaded Anchor Rod: ASTM A36.

D. Nuts: ASTM A563 Grade A.

E. Unhardened Flat Washers: ASTM F844.

2.4 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

1. Manufacturers:

a. Dur-O-Wal; Product Regular D/A 2001: www.dur-o-wal.com.

B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.5 MORTAR MIXES

A. Mortar shall be Type S in accordance with CBC Section 2103A. and ASTM C270 (DSA spec language)

B. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

1. Engineered Masonry; Type S, 1800 psi minimum.

C. When ambient air or masonry temperatures drop below 40 degrees F special provisions of TMS 602, Article 1.8C for cold weather construction shall apply. If temperatures rise above 90 degrees F, special provisions of TMS 602, Article 1.8D for hot weather construction shall apply.

2.6 MORTAR MIXING

A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with TMS 602 Article 2.6A.

B. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.

C. Maintain sand uniformly damp immediately before the mixing process.

D. Add approved admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.

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.

G. Do not use air-entraining admixtures.

2.7 GROUT MIXES

A. All grout for grouted masonry shall conform to ASTM C476 for coarse grout with no lime. Also, see CBC 2104A.1.3.1.2 for high-lift grouting provision.

B. Engineered Masonry: 2,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C94/C94M.

1. Fine grout for spaces with smallest horizontal dimension of 2 inches clear or less.

2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches clear.

C. Aggregate for grout to conform to ASTM C 404, Aggregates for Grout.

D. W/C equal to or greater than 0.7. No water reducing admixtures will be approved.

2.8 GROUT MIXING

A. Mix shall contain specified grout Aid admixtures in accordance with manufacturer's instructions:

1. SikaGrout Aid to be added at a rate of 1 lb. per 100 lb. of cementitious materials per manufacturer’s recommendations

2. Provide for uniformity of mix. Regardless of whether grout is job-mixed or plant-mixed, admixture shall be added per manufacturer’s requirements. Admixture must be combined with water to form a slurry which is then added to the mix in order to avoid “balling” and to get proper distribution of the admixture within the mix.

B. Grout shall not be used more than 90 minutes after initial mixing water has been added to dry ingredients at the jobsite.

C. Mix grout in accordance with ASTM C94/C94M.

D. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

E. Add approved admixtures in accordance with manufacturer's instructions; mix uniformly.

F. Do not use anti-freeze compounds to lower the freezing point of grout.

G. Do not use air-entraining admixtures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Clean reinforcement of loose rust, dirt, mill scale, concrete or other foreign materials which will reduce bond to grout.

C. Clean concrete surfaces to receive masonry. Remove laitance or other foreign material lodged in surfaces by sandblasting or other means as required.

D. Ensure masonry units are clean and free from dust, dirt, or other foreign materials before laying.

E. Provide temporary bracing, forms and shoring during installation of masonry work. Maintain in place until building structure provides permanent bracing and the grout strength meets or exceeds 75% of the required strength.

F. For areas where high-lift grouting will be employed, provide cleanout openings as follows:

1. Hollow Masonry: Not less than 3 inches high at the bottom of each cell to be grouted, formed by cutting out face shell of masonry unit.
    a. Where inverted open-end bond beam units are provided at the bottom of each pour, the cleanout openings need only be located at the bottom of each cell containing reinforcing, and not more than 32 inches on center.

3.3 COURSING

A. Erect masonry in accordance with the California Building Code, latest edition, Chapter 21.

B. Establish lines, levels, and coursing indicated. Protect from displacement.

C. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

D. Concrete Masonry Units:

1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches, unless otherwise noted on architectural drawings.
3. Mortar Joints: Concave, unless otherwise noted on drawings.

3.4 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.

B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

C. Remove excess mortar as work progresses.

D. Interlock intersections and external and internal corners.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

G. Stop masonry work by racking back 1/2 masonry unit length in each course; do not "tooth".

H. Cut mortar joints flush where wall tile is scheduled or where required for finishes or waterproofing.

3.5 REINFORCEMENT AND ANCHORAGE

A. Place reinforcement in accordance with the California Building Code, Chapter 21.

B. Reinforcement Bars: Secure at intervals not exceeding 200 bar diameters and to avoid displacement during grouting.

1. Locate reinforcing splices as indicated on drawings.

C. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.

1. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.

3.6 MASONRY FLASHINGS

A. Install flashing as indicated on Architectural drawings.

3.7 GROUTING

A. Use either high-lift or low-lift grouting techniques, at Contractor's option, as limited below, subject to other limitations of contract documents.

B. Grouting to be per TMS 402/602, Section 3.5.

1. Subject to the additional requirements of Chapter 21A, Section 2104A.5.1.2 of the California Building Code.

2. Do not use high-lift grouting at locations where cleanouts would be exposed to view.

C. Low-Lift for CMU Grouted Construction: Where low-lift grouting is used, the method shall conform with CBC Section 2104A.1.3.1.2.2 requirements.

D. High-Lift for CMU Grouted Construction: Where high-lift grouting is used, the method shall conform with CBC Section 2104A.1.3.1.2.3 requirements, and be approved by the Architect and DSA. An approved admixture that reduces early water loss and produces an expansive action shall be used in the grout. Contractor shall submit a request to use “High-Lift” in accordance with Section 01 33 00.

E. Place grout for spanning elements (beams, lintels, headers) in single, continuous pour.

3.8 CONTROL AND EXPANSION JOINTS

A. Detail horizontal reinforcing at control joints as indicated on drawings.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.9 BUILT-IN WORK

A. As work progresses, install built-in items as furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints and fill frame voids solid with grout, unless otherwise noted on architectural drawings.

3.10 TOLERANCES

A. Comply with TMS 402/602, Section 3.3 F.

3.11 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval from the Architect prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Division 1.

B. Testing and Inspection: Provide special inspection in accordance with the California Building Code, latest edition, Chapters 17 and 21 and per TMS 402/602, Section 1.6 Level B quality assurance.

3.13 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 per manufacturer recommendations.

D. Use non-metallic tools in cleaning operations.

3.14 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

B. Provide protective boards and sheathing at exposed finished walls adjacent to any subsequent concrete placement.

C. Protect all CMU from damage and exposed CMU from discoloration of any type throughout the construction period. Provide protective tarps, boards, etc. as required.

3.15 SCHEDULES

A. See architectural drawings.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Adhesive anchors.

B. Adhesive dowels.

C. Mechanical anchors.

1.2 RELATED SECTIONS

A. Section 05 12 00 - Structural Steel Framing.

B. Section 03 20 00 - Concrete Reinforcement.

1.3 REFERENCES

A. ASTM F436 - Standard Specification for Hardened Steel Washers; 2011.

B. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use; 2019.

C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.

D. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2018.

E. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2015.

F. ASTM F844 ANSI B18.22.1 - American National Standard for Plain Washers; 1981.

1.4 SUBMITTALS

A. See Division 1 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit for each type of adhesive and mechanical anchor. Include current ICC-ESR report.

1.5 DELIVERY, STORAGE, AND PROTECTION

A. Deliver threaded rods and dowels to project site in [bundles], tagged and marked.

B. Store threaded rods and dowels under cover and elevated above grade to prevent damage and accumulation of dirt and rust.

C. Store adhesive system and mechanical fasteners in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide stainless steel fasteners for exterior use and wet locations or when installed into exterior walls.

B. All Thread Rods: ASTM A572/A572M, GR. 50, unless otherwise noted.

C. Steel Nuts: ASTM A563 Grade A, unless otherwise noted.

D. Heavy Hex Nuts: ASTM A563, Grade DH.

E. Plain Unhardened washers: ASTM F844.

F. Hardened Washers: ASTM F436.

G. Dowels: ASTM A615/A615M, Grade 60, unless otherwise noted.

2.2 ADHESIVES

A. Adhesives:

1. For use in Concrete:

a. Manufacturers:

1) Hilti: HIT RE 500-V3; ICC-ESR-3814; www.us.hilti.com.

2) Simpson Strong-Tie: SET-3G; ICC-ESR-4057; www.strongtie.com.

3) Powers: Pure 110+; ICC-ESR-3298; www.powers.com.

2. For use in Masonry:

a. Manufacturers:

1) Hilti: HIT-HY 70; ICC-ESR-2682; www.us.hilti.com.

2) Simpson Strong-Tie: SET-XP; IAPMO-UES ER-265; www.strongtie.com.

3) Powers: AC100+ Gold; ICC-ESR-3200; www.powers.com.

2.3 MECHANICAL ANCHORS

A. Expansion/Wedge Anchors:

1. Concrete Anchorage:

a. Manufacturers:

1) Hilti: KB-TZ2; ICC-ESR-4266; www.us.hilti.com.

2) Hilti: KB1; IAPMO-ER-678; www.us.hilti.com.

3) Simpson Strong-Tie Co.: Strong-Bolt 2; ICC-ESR-3037; www.strongtie.com.

4) Powers: Power-Stud+SD2; ICC-ESR-2502; www.powers.com.

2. CMU Anchorage:

a. Manufacturers:

1) Hilti: KB-3; ICC-ESR-1385; www.us.hilti.com.

2) Simpson Strong-Tie Co.: Wedge-All; ICC-ESR-1396; www.strongtie.com.

3) Powers: Power-Stud SD1; ICC-ESR-2966; www.powers.com.

B. Screw Anchors:

1. Manufacturers:

a. Hilti: HUS-EZ; ICC-ESR-3027; www.us.hilti.com.

b. Simpson Strong-Tie: Titen-HD; ICC-ESR-2713; www.strongtie.com.

c. Powers: Wedge-Bolt+; ICC-ESR-2526; www.powers.com.

C. Powder Actuated Fasteners:

1. Manufacturers:

a. Hilti: X-U; ICC-ESR-2269; www.us.hilti.com

b. Simpson: PDPA; ICC-ER-2138; www.strongtie.com

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install anchors in accordance with the latest ICC-ESR report and the manufacturer instructions.

B. Locate reinforcement and confirm final anchor locations prior to fabricating plates, members or other steel assemblies attached with post-installed anchors.

C. If reinforcing steel is encountered during drilling, abandon and shift the hole location to avoid reinforcement. Provide a minimum of 2 diameters or 1 inch, whichever is larger, of sound concrete between the anchor or dowel and abandoned hole. Do not cut reinforcing.

1. If the anchor cannot be shifted, notify the Architect.

D. Install anchors to the embedment depth noted on the drawings. Embedment depths noted are the effective embedment per manufacturer.

E. Drill anchor holes in clay brick masonry (URM) using a non-impact electric rotary drill.

3.2 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Division 1.

B. Testing of anchors and dowels is to occur no sooner than 24 hours after installation.

C. Replace anchors that fail during testing and retest. If more than 10% of the tested anchors fail to achieve specified test load, test 100% of anchors.

1. Additional testing due to test failures to be paid for by Contractor.

D. Adhesive anchors and dowels:

1. Provide periodic special inspection in accordance with Section 1705.3 of the California Building Code and the ICC-ESR report.

2. Verify adhesive system, expiration date, anchor diameter and anchor grade.

3. Verify hole diameter and location. Observe cleanliness of hole and anchor, adhesive application and anchor embedment.

4. Tension test anchors and dowels to load and frequency as specified on the drawings.

E. Mechanical Anchors:

1. Wedge Anchors, Sleeve Anchors, Undercut Anchors, and Screw Anchors:

a. Provide periodic special inspection in accordance with Section 1705.3 of the California Building Code and the ICC-ESR report.

b. Verify anchor diameter and anchor grade.

c. Verify hole diameter and location. Observe cleanliness of hole and anchor, and anchor embedment.

d. Test anchors to the manufacturer's recommended installation torque or recommended torque in the ICC-ESR report at the frequency specified on the drawings.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Structural steel framing members.

B. Base plates, shear stud connectors and fasteners.

C. Grouting under base plates.

D. Post-installed anchors.

1.2 RELATED REQUIREMENTS

A. Section 05 05 23 - Adhesive And Mechanical Fasteners.

B. Section 05 31 00 - Steel Decking: Support framing for small openings in deck.

1.3 REFERENCE STANDARDS

A. AISC 341 - Seismic Provisions for Structural Steel Buildings; 2016 (Revised 2018).

B. AISC (MAN) - Steel Construction Manual; 2017.

C. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.

D. AISC 360 - Specification for Structural Steel Buildings; 2016.

E. ANSI B18.22.1 - Plain Washers; American National Standards Institute; 1965.

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; 2020.

H. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2018.

I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

K. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications; 2020.

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L. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both; 2020a.

M. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.

N. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014, with Editorial Revision (2017).

O. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021.

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; 2018.

S. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).

T. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2020.

U. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019, with Editorial Revision (2020).

V. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.

W. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series; 2017a.

X. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use; 2019.

Y. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

Z. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

AA. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014 (Amended 2015).

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AB. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.

AC. AWS D1.8/D1.8M - Structural Welding Code - Seismic Supplement; 2016.

AD. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2014, with Errata (2015).

AE. UL (FRD) - Fire Resistance Directory; Current Edition.

1.4 DEFINITIONS

A. Seismic Force Resisting System (SFRS): Members and connections designed to resist seismic forces, including beams, columns, collectors and connections and designated as SFRS on the drawings.

1.5 SUBMITTALS

A. See Division 1 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate grade of steel, profiles, sizes, spacing, lengths and locations of structural members, openings, shop surface treatments, attachments, fasteners, welds, dimensional information, items to be galvanized, and AESS items.

2. Indicate cuts, connections, holes and cambers.

3. Indicate welded connections with AWS A2.4 welding symbols. Indicate size, type and net weld lengths.

a. Identify shop and field welds.

b. Identify Demand Critical (DC) welds requiring specialty filler metal.

4. Include complete details, schedules, procedures, and diagrams for fabrication and assembly.

5. Do not reproduce construction documents.

6. Other procedures, along with test required to qualify in accordance with AWS Code Section 4.1.1, shall be submitted to testing agency, DSA and Structural Engineer of Record for approval prior to use.

C. Manufacturer's Product Data: Provide for welding electrodes and filler metals, bolts, nuts, washers, direct tension indicators, couplers, and blind bolts.

1. Identify locations of use for welding electrodes.

2. Provide data indicating capacity of couplers.

3. Provide current ICC-ESR report for blind bolts indicating design capacities and acceptance for use under static and seismic loads.

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D. Manufacturer's Certificate of Conformance: Certify that fasteners, welding electrodes, shear stud connectors, grout, and primer meet or exceed specified requirements.

E. Mill Test Reports: Indicate structural strength, and other properties required by the ASTM specification, including, destructive test analysis and non-destructive test analysis.

1. Provide for all structural steel, bolts and fasteners, and shear stud connectors.

F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work. Submit for independent agency review.

G. Welding Procedure Specification (WPS) and, as required, WPS Qualification Records: Submit to Architect and to independent testing agency for review. Submit only for welds applicable to project.

H. AISC Certification Statement: **Certification of the steel fabricator and erector is preferred but not required.**

I. Post-Installed Anchor Product Data: Submit for each type of adhesive and mechanical anchor.

1.6 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual", AISC "Code of Standard Practice for Steel Buildings and Bridges" and AISC 341 "Seismic Provisions for Structural Steel Buildings".

B. Maintain one copy of each document on site.

C. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience who participates in the AISC Certification program and is designated and is designated an AISC Certified Plant, Category BU at time of bid.

D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.8/D1.8M to perform type of welds required.

E. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience who participates in the AISC Certification program and is designated an AISC Certified Erector, Category ACSE.

F. Welders: Qualified in accordance with AWS D1.1 and AWS D1.8/D1.8M to perform type of welds required.

G. Fabricator and erector to comply with Quality Control (QC) requirements of Chapter N of AISC 360, Chapter J of AISC 341, and as modified by Chapter 17A of the CBC.

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H. An independent testing agency, as specified in Division 1, is to provide Quality Assurance (QA) tasks per Chapter N of AISC 360, Chapter J of AISC 341, and as modified by Chapter 17A of the CBC.

I. All testing and inspection shall be in accordance with CBC, Chapter 17A, and Chapter 22A.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. Store materials to permit easy access for inspection and identification.

C. Store materials supported off the ground.

D. Protect materials from rust corrosion, keep free of dirt, grease and other foreign matter.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Conform to UL (FRD) Assembly Design as designated in 07 81 00 - Applied Fire Protection for restrained ratings with no load restrictions.

2.2 MATERIALS

A. Steel Angles and Channels: ASTM A36/A36M.

B. Steel W Shapes and Tees: ASTM A992/A992M.

1. Heavy Sections, with flanges 1 1/2 inches thick and thicker. Provide with charpy v-notch values in accordance with AISC 360, Section A3.1c and AISC 341, Chapter A3.3.

C. Steel Plates: ASTM A36/A36M or ASTM A572/A572M, Grade 50 (345) as indicated on the drawings.

1. Plates 2 inches thick and thicker: Provide with charpy v-notch values in accordance with AISC 360 Section A3.1d and AISC 341, Chapter A3.3.

D. Cold-Formed Structural Tubing (HSS): ASTM A500/A500M, Grade B.

E. Pipe: ASTM A53/A53M, Grade B, Finish black.

F. Stainless Steel Shapes, Plates and Bars: ASTM A276/A276M, Type 304L.

G. Shear Stud Connectors: Made from ASTM A108 Grade 1010 through 1020 bars and in accordance with AWS D1.1/D1.1M.

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H. Threaded Stud Connectors: Made from ASTM A 108 Grade 1015 bars and in accordance with AWS D1.1/D1.1M.

I. Machine Bolts and Nuts: Carbon steel, ASTM A307, Grade A, with ASTM A563 nuts.

J. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, Grade A325 with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.

K. Coupler: Capacity to meet or exceed ultimate tension capacity of threaded rod being coupled.

L. Stainless Steel Bolts: ASTM A193/A193M, B8M Class 1.

M. Anchor Rods / Anchor Bolts: ASTM F1554, Grade 55 with weldable supplement S1, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436 Type 1 washers.

N. All-Thread and Partially Threaded Rod: ASTM A 572/A 572M, Grade 50.

O. High-Strength All-Thread and Partially Threaded Rod: ASTM A193/A193M, B7 GR105.

P. Stainless Steel All-Thread and Partially Threaded Rod: ASTM A193/A193M, B8M Class 2.

Q. Unhardened Flat Washers: ASTM F844 and ANSI B 18.22.1.

R. Beveled Washers: ASTM F436.

S. Stainless Steel Washers: ASTM A276/A276M, Type 304.

T. Stainless Steel Nuts: ASTM A194/A194M, GR8M.

U. Load Indicator Washers: Permitted for pretensioning of bolts. Provide washers complying with ASTM F959/F959M.

V. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

1. Electrodes to be low hydrogen types E7XTX, E7XTXX or E70XXX as applicable.

2. At the following locations, electrodes to meet the requirements of AWS D1.8/D1.8M, Clause 6.3.1 through 6.3.8, with Charpy V-Notch (CVN) test values of a minimum 20 foot-pounds at 0 degrees fahrenheit and 40 foot-pounds at 70 degrees fahrenheit. Where service temperatures are expected to be below 50 degrees fahrenheit Where service temperatures are expected to be below 50 degrees farenheit, including unconditioned penthouses, unconditioned spaces and exterior framing, electrodes to meet the CVN properties per Clause 6.3.6.

a. Welds of the Seismic Force Resisting System (SFRS) and Demand Critical (DC) welds as indicated on drawings and occurring at:

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1) Complete penetration welds

2) Beam to column moment connections: Including flange, web, doubler plates, base plates, and continuity plate fillet and partial joint penetration welds.

W. 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.

X. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction. Primer to be compatible with finish materials.

Y. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction. Primer to be compatible with finish materials.

2.3 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Provide camber for beams and girders as indicated on the drawings.

1. Provide natural camber up, unless otherwise noted, except at cantilevers. At cantilevers provide camber such that tip of cantilever is above final elevation.

C. Where weld size not noted in symbol, provide weld size (E) minimum per AWS prequalified welded joints.

D. At exterior painted assemblies provide seal welding of edges of all overlapping or contacting surfaces of parts.

E. At galvanized assemblies:

1. Provide seal welding of edges of all overlapping or contacting surfaces of parts.

2. Provide vent holes as required. Submit locations for review and approval.

2.4 FINISH

A. Prepare structural component surfaces in accordance with SSPC SP -1 and SP-2 or Sp-3, in accordance with paint manufacturer's recommendations.

B. Shop prime structural steel members in accordance with manufacturer's instructions. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, galvanized, or at faying surfaces of slip critical bolted connections.

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C. Faying Surfaces of Slip Critical Joints: Provide Class A typical and Class C at hot-dip galvanized surfaces, in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using ASTM A325 or A490 Bolts". Slip critical joints identified as "SC" on the drawings.

D. Galvanize structural steel members to comply with ASTM A123/A123M.

E. Hot-dip galvanized ASTM F1554 rods to be in accordance with ASTM F2329.

F. Fasteners exposed to exterior to have galvanized finish per ASTM A153/A153M.

2.5 SOURCE QUALITY CONTROL

A. An independent testing agency will perform source Quality Assurance (QA) and testing and inspections per this section, as specified in Division 1.

B. Fabricator is to provide source Quality Control (QC) as required by the standards specified in this section.

C. Material Verification: Verify materials in accordance with the California Building Code Section 1705.A, AISC 360 Section N5 and AISC 341 Section J6.

D. Welded Connections and Procedures: Provide review, visual inspection and non-destructive testing in accordance with the California Building Code Section 1705, AISC 360 Section N5.4 and N5.5 and AISC 341 Section J6.

E. Stud Connections: Provide testing and inspection of welded stud connections in accordance with AWS D1.1/D1.1M Clause 7.

F. Test and inspect High Strength Bolts and installation in accordance with CBC Section 1704A.3.3 and 2213A.1.

G. Test end weld studs in accordance with CBC Section 2213A.2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.2 ERECTION

A. Erect structural steel in compliance with AISC 303.

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.

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C. Coordinate work and cooperate with independent testing agency to allow all tests and inspection procedures to be properly provided.

D. Provide anchor rods, nuts, plate washers and 1/8 inch thick minimum anchor bolt setting templates as required by work of other sections.

E. Install bolts in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts" as follows:

1. Bolted connections: Pretensioned, unless otherwise noted.

2. Slip Critical: Pretensioned with specified faying surface, where noted on the drawings.

3. Bolts installed through HSS members (outside face to outside face): Snug tightened.

4. Bolts installed in long-slotted holes: Finger-tight and double-nut or mar threads to prevent backoff of nut. Provide 0 to 1/16 inch max gap between plies of joint, not fully tightened, to allow movement in the connection.

F. Provide beveled washers under bolt heads or nuts resting on surfaces exceeding 5 percent slope relative to the head or nut.

G. Perform welding in accordance with AWS D1.1/D1.1M, AWS D1.8/D1.8M and AISC 341.

H. Weld shear stud connectors in accordance with AWS D1.1/D1.1M and the manufacturer's instructions.

I. Do not field cut or alter structural members without approval of Architect.

J. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

K. Repair galvanized steel in accordance with ASTM A780/A780M.

L. 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.

3.3 TOLERANCES

A. Comply with the AISC S303 "Code of Standard Practice for Steel Buildings and Bridges"

3.4 FIELD QUALITY CONTROL

A. An independent testing agency will perform field Quality Assurance (QA) and tests and inspections per this section, as specified in Division 1.

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B. Erector is to provide field Quality Control (QC) as required by the standards specified in this section.

C. Bolts: Provide special inspection in accordance with the California Building Code Section 1705, AISC 360 Section N5.6 and AISC 341 Section J7.

D. Welded Connections and Procedures: Provide review, visual inspection and non-destructive testing in accordance with the California Building Code Section 1705, AISC 360 Section N5.4 and N5.5, and AISC 341 Section J6.

E. Stud Connectors: Provide inspection and testing of stud connectors in accordance with AWS D1.1/D1.1M, Clause 7.

F. Grout: Review mixing of grout under base plates and sample using four 2-inch mortar cubes. Test for ultimate compressive strength at 1, 7 and 28 days after placing and hold the fourth cube until the end of the project. Sample one set minimum for each day that grout is placed.

3.5 TESTING & INSPECTION FOR STRUCTURAL STEEL

A. Test and inspect High Strength Bolts and installation in accordance with CBC Section 1704A.2.5 and 2213A.1.

B. Test end weld studs in accordance with CBC Section 2213A.2.

C. Inspect welding in accordance with CBC Section 1705A.2 and 2204A.1. Welding shall be done under supervision of recognized testing laboratory by qualified Inspector approved by DSA, who will furnish Architect, Structural Engineer and DSA with report, duly verified by both Inspector and Laboratory, that the welding is adequate and has been done in conformity with Drawings and Specifications and that Laboratory has used every means necessary to determine quality of weld. Testing Laboratory may use gamma ray, magnaflux, trepanning, or other non-destructive aid to visual inspection which it deems necessary to assure itself of adequacy of welding. Every layer of weld shall be inspected for quality and every welded joint shall be inspected for quality and every welded joint shall be inspected for agreement with Drawings.

D. Inspect shop fabrication of steel trusses and steel braced frames in accordance with CBC Section 1704A.3. The Inspector shall furnish the Architect, Structural Engineer and the Division of the State Architect a report that the materials and workmanship conform to the approved plans and specifications.

E. Shop Welding Inspection

1. Testing Agency shall inspect and certify all structural welds, unless the fabricating shop has been accredited in conformance with CBC requirements. Submit certification to the Architect/Engineer for review and the Building Official for approval.

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2. Welder Qualifications: Welding inspector shall verify that all the welders are properly qualified prior to steel fabrication and state the qualifications of each welder in the welding inspection report.

3. Welding Inspection: Continuous inspection required unless otherwise noted below. Comply with requirements of AWS D1.1

   a. Welding Inspector shall check all welds, materials, equipment and procedures.

   b. Welding Inspector shall provide reports certifying the welding is as required and has been done in conformity with the plans, specifications and codes.

   c. Welding Inspector shall use radiographic, ultrasonic, magnetic particle, or any other necessary aid to visual inspection to assure adequacy of welds.

4. Periodic Inspection Acceptable:

   a. Single pass fillet welds not exceeding 5/16.

   b. Welding of studs to beams.

END OF SECTION

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PART 1 – GENERAL

1.1 SUMMARY

A. Section includes provision of modular steel strut system components, including channel strut, fittings, threaded rod and fasteners for support of architectural components, conduit, pipe, or ductwork as shown or specified elsewhere.

B. Related Sections:

1. Section 05 50 00 – Metal Fabrications: Provision of miscellaneous steel shapes, fastenings and anchors required for complete support assemblies.

2. Division 21 – Fire Protection: Support of fire protection and fire suppression components.

3. Division 22 – Plumbing: Support of plumbing components.

4. Division 23 – Mechanical: Support of mechanical components including ducts and pipes.

5. Division 26 – Electrical: Support of electrical components.

6. Division 27 – Communications: Support of communications components.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM A123 “Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip”.

2. ASTM A653 “General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process”.

3. ASTM A907 “Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled, Structural Quality”.

4. ASTM A1011 “Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formablility” (Formerly ASTM A570).

5. ASTM B633 “Specification for Electrodeposited Coatings of Zinc on Iron and Steel”.

6. ASTM F1136 “Standard Specification for Chromium/Zinc Corrosion Protective Coatings for Fasteners”.

B. National Fire Protection Association (ANSI/NFPA).

1. NFPA 70 – Article 352 “Surface Metal Raceways and Surface Nonmetallic Raceways” for NEC compliance.

C. Metal Framing Manufacturers Association (MFMA).

1. MFMA-3 “Metal Framing Standards Publication”.

D. Underwriter’s Laboratory (UL).

1. UL 5 “Standard for Surface Metal Raceway and Fittings”.

E. American Iron and Steel Institute (AISI)

1.3 QUALITY ASSURANCE

A. Manufacturers: Companies regularly engaged in the manufacture of bolted metal strut channel framing systems of the types required for not less than 5 years.

B. Components: All parts provided shall be that of a single manufacturer, with manufacturer’s name, part number and material heat code identification number stamped on channels and fittings for identification. Material certification sheets and test reports must be made available by the manufacturer upon request.

C. Component manufacture and installation shall comply with referenced standards.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product data: Submit manufacturer's product data on strut channels including, but not limited to, types, materials, finishes, gauge thickness, and hole patterns. For each different strut cross-section, submit cross sectional properties including Section Modulus (Sx) and Moment of Inertia (Ix).

C. Shop Drawings to show details, fabrication, installation, anchorage, catalog numbers and interface of the Work of this Section with the Work of adjacent trades.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver materials in original, tightly sealed containers or unopened packages with manufacturer's name, labels, and product identification intact.

B. Storage and Protection: Store materials out of weather in original containers or unopened packages as recommended by manufacturer.

C. Provide a copy of manufacturer data sheet or letter with percentages of pre and post-consumer recycled content, and provide materials cost

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. General: Furnish compliant system of any of the below manufacturers or approved equal. If the drawings indicate that assemblies are based upon a specific agency-listed pre-approval, furnish the product of the manufacturer listed under that pre-approval. Unless otherwise noted, specific components identified on drawings are based upon Unistrut Corporation as the design basis.

1. Cooper B-Line.
2. Thomas & Betts.
3. Unistrut Corporation.

2.2 MATERIALS

A. General: All specified component characteristics are typical unless indicated otherwise on drawings.

B. Strut Material and Finish: ASTM A653 or ASTM A1011 SS (GR33), 12 gauge, G90 hot-dipped pre-galvanized steel strut unless otherwise indicated. Strut shall be 1-5/8 inches wide in varying heights and welded combinations as required to meet load capacities and designs shown.

1. Strut Fittings: ASTM-compliant, hot-dipped galvanized.

2.3 NUTS AND HARDWARE

A. General: ASTM B633 electrogalvanized channel nuts, screws, nuts, threaded rod, couplings and other accessories required for a complete assembly.

PART 3 – EXECUTION

3.1 COORDINATION

A. Coordinate as required with other trades to assure proper and adequate provision in the Work of those trades for interface with the Work of this Section.

3.2 FIELD MEASUREMENTS

A. Make field measurements to assure that the strut system components can be installed according to plans, and without interference with structural framing, mechanical systems, plumbing or other obstructions. Any conflicts shall be reported to the Architect.

3.3 INSTALLATION

A. General:

1. Set Work accurately into position, plumb, level, true, and free from rack.
2. Seismic brace and anchor firmly into position as shown.

3. Do not cut, weld, or abrade surfaces which are intended for bolted or screwed field connections.

B. Install in compliance with referenced standards and manufacturer's installation instructions. Tighten all connections to their recommended torques.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Roof deck.

B. Supplementary framing for openings up to and including 18 inches.

C. Bearing plates and angles.

D. Deck fastening

E. Deck Shoring

1.2 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

C. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014 (Amended 2015).

D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.

E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.

F. ICC-ES AC70 - Acceptance Criteria for Fasteners Power Driven into Concrete, Steel and Masonry Elements; 2016.

G. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.

H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.4 SUBMITTALS

A. See Division 1 - Administrative Requirements, for submittals procedures.

B. Product Data: Provide deck profile characteristics, dimensions, structural properties, installation instructions, ICC-ESR report, powder actuated fastener information, welding electrodes, and finishes.

C. Shop Drawings: Indicate deck plan, support locations, projections, openings, deck reinforcement, supplementary framing, deck type, deck orientation, fasteners, welds, shoring, pertinent details, and accessories.

D. Certificates: Certify that products meet or exceed requirements for each heat of steel and requirements for welding electrodes.

E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.5 QUALITY ASSURANCE

A. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.

B. Use materials and products of one manufacturer whenever possible.

C. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Project Inspector. Work not so inspected is subject to uncovering and replacement.

D. Certification: Manufacturer's certification of compliance with the specification.

E. Sheet Steel Welding:

1. General: All welding shall be in compliance with Section 05 12 00 and applicable provisions of 2016 CBC Chapter 2210A.

2. Welders: Qualified for each light gauge welding process to be used in fabrication and AWS certified

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver store and handle decking in a manner to prevent damage or deformation.

B. Cut plastic wrap to encourage ventilation.

C. Store deck on dry wood sleepers; slope for positive drainage.

1.7 TESTING AND INSPECTION

A. All steel decking layout and field welding of decking to supports and to decking will be inspected and certified by the Owner's Testing Laboratory.

B. Material certification per CBC, Section 2203A.1.

C. Welding inspection per CBC, Section 2204A.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Deck:

1. Verco Manufacturing, Co;: www.vercodeck.com.
2. ASC Profiles: www.ascsd.com
3. Deck West, Co;: www.deckwest.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 STEEL DECK

A. Roof Deck: Non-composite type, fluted steel sheet:

1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G60/Z180 galvanized coating.
2. Structural Properties: as noted on drawings.

2.3 ACCESSORY MATERIALS

A. Plates and Angles: ASTM A36/A36M steel, unfinished.

B. Edge of Slab Bent Plate: ASTM A36/A36M, bent steel plate as detailed on the drawings.

C. Welding Materials: AWS D1.1/D1.1M, type required for materials being welded.

1. Electrodes to be low hydrogen type E7XTX, E7XTXX, or E70XXX as applicable.

D. Powder Actuated Mechanical Fasteners: Type as indicated on drawings. Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.

E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

F. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.4 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 16 gage thick sheet steel unless otherwise noted; of profile and size as indicated; finished same as deck.

B. Roof Sump Pans: 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight. Unless otherwise noted on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.2 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On steel supports provide minimum 2 inch (50 mm) bearing.

C. Fasten deck to steel support members at ends and intermediate supports with attachment type, size and spacing as indicated on the drawings.

D. Attach seam side laps as indicated on the drawings.

E. Remove water from deck and supporting steel prior to welding.

F. Weld deck in accordance with AWS D1.3/D1.3M.

G. At deck openings provide supplemental steel and/or slab reinforcing as indicated on the drawings.

H. Provide sheet steel closures and angle flashings to close openings, unless otherwise noted on the drawings. At openings between edge of deck and concrete walls and other concrete elements, provide sheet steel closures below upper flutes only and do not obstruct continuity of concrete in down flutes.

I. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

J. Provide shoring of metal decking in accordance with the ICC ESR report where construction loads exceed deck capacity and as indicated on the drawings.

K. Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.

L. After cutting or welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, exposed on bottom surface of deck, with galvanizing repair paint, or touch-up primer for painted decking.

3.3 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests and inspections, as specified in Division 1.

B. Review installed condition of deck units, framed openings, and accessories.

C. Deck Fasteners: Verify the size, type, spacing, and penetration.

D. Deck Welds: Inspect in accordance with the California Building Code Section 1705 and AWS D1.3/D1.3M Clause 6.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes design and provision of formed steel stud exterior wall and soffit framing to resist lateral and uplift loads; accessories such as clips, stiffeners, bridging, bracing and fasteners.

1. Sub-framing components.

B. Related Sections:

1. Division 3: Concrete
2. Section 07 54 23 – Thermoplastic Polyolefin Roofing: Provision of required backing.
3. Section 07 21 16 - Blanket Insulation: Insulation within framing members.
4. Section 07 26 00 - Vapor Retarders.
5. Section 07 27 26 – Fluid-Applied Membrane Air Barriers.
6. Division 8: Coordination of framing for installation and support of doorway and glazing system openings.
7. Section 09 21 16 - Gypsum Board Assemblies: Gypsum sheathing; non-load bearing interior metal stud framing.

8. Section 09 24 00 – Cement Plastering.

1.2 REFERENCES

A. American Iron and Steel Institute:

1. AISI General - Standard for Cold-Formed Steel Framing - General Provisions.
2. AISI Header - Standard for Cold-Formed Steel Framing - Header Design.
3. AISI NAS - North American Specification for Design of Cold-Formed Steel Structural Members.

B. ASTM International:

1. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
2. ASTM A1003 - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
3. ASTM B 633: Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

4. 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.

5. ASTM C1007 – Installation of Load Bearing Steel Studs and Related Accessories.

6. ASTM C 1513: Specifications for Steel Tapping Screws for Cold-Formed Steel Framing Connections.

C. American Institute of Steel Construction

1. LRGD Steel Construction Manual, 14th Edition.

D. American Iron and Steel Institute

1. Specification for the Design of Cold-Formed Steel Structural Members.

E. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

2. AWS D1.3 - Structural Welding Code - Sheet Steel.

F. Gypsum Association:

1. GA-600 – Fire Resistance Design Manual.

G. SSPC: The Society for Protective Coatings:

1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

H. Steel Stud Manufacturers Association:

1. SSMA - Product Technical Information.

I. Underwriter's Laboratories

1. UL Directory.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal requirements.

B. Product Data: Submit data on standard framing members; describe materials and finish, product criteria, limitations.

C. Shop Drawings:

1. Indicate member size and gage designations, number, type, location and spacing, component details, framed openings, anchorage, welds, type and location of fasteners, and accessories or items required of related Work. Show

reinforcing channels, supplemental framing, strapping, bracing, bridging, splices, accessories, and attachment to adjoining work.

2. Large scale, dimensioned shop drawings of all assemblies. Indicate stud and soffit joist layout.

3. Describe method for securing studs to tracks and for bolted or welded framing connections.

D. Mill Certifications: Submit mill certifications for steel delivered to site. Certify steel bare metal thickness in 0.001 inch, yield strength, tensile strength, total elongation in 2 inch or 8 inch gauge length, chemical analysis, and galvanized coating thickness.

E. Welding Certificates: Copies of certificates for welding procedures and personnel.

F. Research/Evaluation Reports: For cold-formed steel framing.

G. Metal stud manufacturer to have a 3rd party evaluation report, (ICC ESR), for its products that are reviewed per CBC 2013 and AISI S100.

H. Provide a copy of manufacturer data sheet or letter with percentages of pre and post-consumer recycled content, and provide materials cost

1.5 QUALITY ASSURANCE

A. Furnish framing materials in accordance with SSMA - Product Technical Information.

B. Perform Work in accordance with the following:

1. Framing: AISI General and AISI NAS.

2. Headers: AISI Header.

3. Wall Studs: AISI WSD.

4. Lateral Design: AISI Lateral.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience and a current member of Steel Stud Manufacturers Association.

B. Installer: Company specializing in performing Work of this section similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of in-service performance.

C. Welding: Qualify procedures and personnel according to AWS D1.1 and AWS D1.3.

D. Fire-Test-Response Characteristics: Where metal framing is part of a fire-resistive rated assembly, provide framing identical to that of assemblies tested for fire

resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire Resistance Ratings: Indicated by GA File Numbers in GA-600, or by design designations from UL Directory, or from the listings of another testing and inspecting agency.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products in a manner to prevent damage and deterioration, including rust.

B. Store materials above the ground in a dry area, in manufacturer's original packaging. Keep labels showing product type, name and grade intact.

PART 2 – PRODUCTS

2.1 COLD-FORMED METAL FRAMING

A. Manufacturers: Compliant products of one of the following, or approved equal.

1. California Expanded Metal Products Company / CEMCO.
2. ClarkDietrich Building Systems LLC.
3. SCAFCO Corporation.
4. Steeler, Incorporated.

B. Cold-Formed Metal Framing: ASTM C955.

2.3 FRAMING COMPONENTS

A. Steel Sheet: ASTM A1003; Structural Grade, Type H, metallic coated.

1. Grade: ST50H for 16-gauge and heavier members.
2. Coating: G60 galvanized.

B. Studs: Steel sheet, formed to C-shape, punched web; thickness (gauge) as shown on drawings, 1.625 inch minimum face (flange) and 6 inch minimum depth unless indicated otherwise on Drawings.

C. Track: Steel sheet, formed to channel shape; same width and thickness (gauge) as studs, tight fit; solid web.

D. Slotted Track: Steel sheet, formed to channel shape; same width and thickness (gauge) as studs, tight fit; solid web. Slotted track shall have 2-1/2 inch minimum face (flange) with slotted holes to accommodate a total vertical movement of 1-1/2 inch minimum. Slotted track shall have minimum 1-1/2 inch long slotted holes in web to accommodate horizontal drift.

2.4 SUB-FRAMING COMPONENTS

A. Z-Girts: ASTM E84; composite metal hybrid subframing consisting of polyester resin matrix, fire-retardant additives and integral G90 galvanized metal reinforcing inserts at fastening locations. Engineered to limit thermal bridging across exterior insulation beneath exterior cladding. Basis of specification: SMARTciSystems' "GreenGirt CMH Sub-Framing" or approved equal.

1. Depth of Girt: As indicated on Drawings to accommodate rigid exterior insulation.

2. Orientation and Spacing: As indicated on Drawings.

3. Mechanical Strength Requirements: Meet product literature of named manufacturer product.

2.5 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined by performance requirements specified.

B. Plates, Gussets, Clips: Formed sheet steel, thickness determined by performance requirements specified.

C. Backing Plates: Formed steel sheet or c-shapes if indicated, 16 gauge or thickness as indicated.

D. Touch-Up Primer for Galvanized Surfaces: ASTM A780 or SSPC Paint 20.

E, Bridging:

1. Cold-rolled channel: 1-1/2 by 1/2-inch by 54-mil thick.

2. Bridging clip: BridgeClip by the Steel Network, or equal. Provide attachment through stud punch-out clamping onto stud web and wrapping around bridging channel. Provide holes for screw attachment to stud web and channel.

3. Flat strap: Width and thickness required by structural design calculations. Rigid attachment to stud flange.

4. Solid bridging: Channel-shaped bridging with lipped flanges and integral formed clips, BridgeBar by the Steel Network, or equal, screw attachment to stud, 33-mil minimum thickness, size as required by structural design calculations.

2.6 FASTENERS

A. Self-drilling, Self-tapping Screws, Bolts, Nuts, and Washers: Steel, hot dip galvanized unless otherwise indicated on Drawings. Pan or hex washer head complying with ASTM C 1513. Provide screw type and size required drawings.

B. Anchorage Devices: Power actuated, drilled expansion bolts: Steel, hot dip galvanized unless otherwise indicated on Drawings.

C. Welding: In conformance with AWS D1.1 and AWS D1.3.

2.7 GALVANIZING REPAIR

A. Where galvanized surfaces are damaged, prepare surfaces and repair them in compliance with procedures specified in ASTM A 780 using zinc-rich paint.

B. Galvanizing repair (zinc-rich) paint: Tneme-Zinc 90-97 by Tnemec Co., Catha-Coat 303H by Devoe Coatings or Amercoat 68HS by PPG, ZRC by ZRC Worldwide or equal.

2.8 FABRICATION

A. Shop fabrication, where applies:

1. Fabricate assemblies of formed sections of sizes and profiles required.

2. Fit, reinforce, and brace framing members to suit design requirements.

3. Fit and assemble in largest practical sections for delivery to site, ready for installation.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces and building framing components are ready to receive Work. Verify that inserts, clips, and similar attachment devices installed as work of other sections are located and installed properly.

C. Verify rough-in utilities are in proper location.

3.2 ERECTION OF STUDS

A. Comply with requirements of ASTM C1007 except where exceeded by other requirements.

B. Field cutting is allowed with saws or shears, but not torch cutting. Restore damaged zinc coating as specified.

C. Reinforce holes cut thru the studs.

D. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners or by welding as shown on Drawings, at maximum 24 inches oc, and in accordance with approved shop drawings. Coordinate installation of sealant with floor and ceiling tracks where indicated.

1. Provide slotted track at stud heads to provide for vertical movement and drift of adjoining structure without loading of the metal framing.

E. Place studs at not more than 16 inches oc; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using fasteners, or welding method where indicated, at both inside and outside flanges

F. Construct corners using minimum three studs. Double stud wall openings, door jambs, and window jambs.

G. Erect - studs one piece full length. Splicing of studs is not permitted.

H. Coordinate placement of insulation in multiple stud spaces after erection.

I. Install intermediate studs above and below openings to align with wall stud spacing.

J. Install studs with deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

K. Attach cross studs or furring channels to studs for attachment of fixtures anchored to walls.

L. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

M. Install backing plates as required for roofing system and flashing securement.

N. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of the stud system.

O. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches on center.

P. Touch-up field welds and damaged metallic coatings with primer to match shop coating.

Q. Complete framing ready to receive gypsum board and sheathing panels, cladding and roofing systems.

3.3 SUB-FRAMING INSTALLATION

A. Install Z-Girt sub-framing with orientation and spacing as shown. Fasten to cold-formed metal studs or concrete substrates with fasteners in accordance with manufacturer's instructions.

3.4 ERECTION TOLERANCES

A. Install cold-formed metal framing level, plumb and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

A The Owner will employ a qualified testing laboratory to perform the following tests and submit test reports.

B. Testing agency will review and approve Weld Procedure Specifications submitted by the Contractor. The testing agency shall visually observe welding procedures to certify the WPS plan is followed.

C. Perform visual inspection of a minimum of 20 percent of all welds.

Additional testing will be required for the following:

a. If more than 5 percent of the tested welds are rejected, than an additional 20 percent of all the welds shall be tested. This additional testing process shall be repeated until the rejection rate drops below 5 in 100.

b. Costs of additional inspection required by this paragraph shall be borne by the Contractor.

D. Inspections and testing shall be in conformance with the CBC.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes provision of shop fabricated metal items and related accessories and fasteners as indicated in Drawings, including but not necessarily limited to the following:

1. Metal handrails and guardrails as indicated on drawings..
2. Fasteners and anchors for framing and miscellaneous anchorages.
3. Structural supports for miscellaneous anchorages.
4. Ledge and shelf angles.
5. Standard steel pipe handrails and railings.
6. Ladders.
7. Elevator sill angles.
8. Bollards.
9. Z-girts

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 05 16 00 – Strut Channel Framing System.
3. Section 05 40 00 – Cold Formed Metal Framing.
4. Section 06 10 53 – Miscellaneous Rough Carpentry.
5. Section 09 21 16 – Gypsum Board Assemblies.
6. Section 09 90 00 – Painting and Coatings: Field applied paint finish.
7. Division 22 – Plumbing: Supports and anchorages.
8. Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC): Supports and anchorages.
9. Division 26 – Electrical: Supports and anchorages.

1.2 REFERENCES

A. Aluminum Association (AA)

1. AA DAF-45 – Designation System for Aluminum Finishes

B. American Architectural Manufacturers Association (AAMA)

1. AAMA 611 – Voluntary Specification for Anodized Architectural Aluminum.

2. AAMA 2604 – Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

3. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

C. American National Standards Institute

1. ANSI A14.3 – Ladders – Fixed – Safety Requirements

D. ASTM International

1. ASTM A36 – Standard Specification for Carbon Structural Steel.

2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

4. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

6. ASTM A312 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.

7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

8. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

9. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.

10. ASTM A992 - Standard Specification for Structural Steel Shapes.

11. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

12. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.

13. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

14. ASTM F436 – Standard Specification for Hardened Steel Washers.

E. American Welding Society (AWS)

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

2. AWS D1.1 – Structural Welding Code – Steel
3. AWS D1.6 – Structural Welding Code – Stainless Steel

F. California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 7 (CCR):

1. GISO – General Industry Safety Orders: Group 1 General Physical Conditions and Structures Orders.

G. California Code of Regulations, Title 24, Part 2 (CCR):

1. CBC – California Building Code: Design of architectural components.

H. National Association of Architectural Metal Manufacturers (NAAMM)

1. AMP 521 – Pipe Railing Systems Manual.

I. National Ornamental & Miscellaneous Metals Association (NOMMA)

1. NOMMA Guideline 1 – Joint Finishes.

J. The Society for Protective Coatings (SSPC)

1. SSPC - Steel Structures Painting Manual.
2. SSPC SP 1 – Solvent Cleaning.
3. SSPC SP 10 – Near-White Blast Cleaning.
4. SSPC Paint 20 – Zinc Rich Primers (Type I – Inorganic and Type II – Organic).

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Welders shall be qualified in accordance with AWS D1.1.

B. Design Criteria:

1. Finish joints in accordance with NOMMA Guideline 1.
2. Built-up parts shall not exhibit warp.

1.4 SUBMITTALS

A. Manufacturer’s literature describing products including details and dimensions.

B. Shop Drawings:

1. Show large scale construction of various parts, methods of joining, thickness of metals, profiles of surfaces, reinforcing, anchorage, and structural supports. Include information regarding concealed and exposed joints, welds, and fastenings.
2. Where welded connectors and concrete inserts are required to receive work, show size and locations required.

C. Samples: Submit three 8 inches by 4 inches samples of any aluminum anodic or fluoropolymer finish.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

E. Provide a copy of manufacturer data sheet or letter with percentages of pre and post-consumer recycled content, and provide materials cost

1.5 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. Discharge materials carefully and store on clean concrete surface or raised platform in safe, dry area.

1.6 JOB CONDITIONS

A. Scheduling, Sequencing:

1. Ensure timely fabrication of items to be embedded or enclosed by other work.

2. Furnish information and assistance required for locating embedded items and be responsible for proper locations.

PART 2 – PRODUCTS

2.1 COMPONENTS - STEEL

A. Steel Plates, Channels, Angles, and Tees: ASTM A36.

B. Steel Plate: ASTM A572, Grade 50.

C. Steel Tubes: ASTM A500, Grade B.

D. Steel Pipe: ASTM A53, Grade B, Schedule 40.

E. Steel Sheet: ASTM A653, Grade 33 Structural Quality, Galvanized.

F. Bolts: ASTM A307 Grade A or ASTM A325, Type 1.

G. Nuts: ASTM A563 heavy hex type.

H. Washers: ASTM F436, Type 1.

I. Welding Materials: AWS D1.1; type required for materials being welded.

J. Shop Primer: SSPC Paint 15, Type 1, red oxide.

K. Touch Up Primer: Match shop prime, or SSPC Paint 20 for Galvanized surfaces

2.2 COMPONENTS – STAINLESS STEEL

A. Bars and Shapes: ASTM A276, Type 304 unless shown otherwise.

B. Tubing: ASTM A269, Type 304 unless shown otherwise.

C. Pipe: ASTM A312, Type 304 unless shown otherwise.

D. Plate, Sheet and Strip: ASTM A240, Type 304 unless shown otherwise.

E. Bolts, Nuts and Washers: ASTM A354.

F. Welding Materials: AWS D1.6; type required for materials being welded.

2.3 COMPONENTS – ALUMINUM

A. Extruded Aluminum: ASTM B221, Alloy 6063, Temper T5.

B. Sheet Aluminum: ASTM B209.

C. Bolts, Nuts and Washers: Stainless Steel.

D. Welding Materials: AWS D1.1, type required for materials being welded.

2.4 COMPONENTS - ANCHORS

A. Anchor Rods: ASTM A307, Grade A or ASTM F1554, Grade 55, weldable. Furnish with nut and washer, unfinished.

B. Expansion Anchors: Commercial Item Description A-A-1923A Type 4, carbon or stainless steel as indicated, valid ICC-ES Evaluation Report: Hilti Corporation's "Kwik Bolt TZ" (ICC ESR-1917) or Simpson Strong Tie's "Strong-Bolt" (ICC ESR-1771).

1. Patching Mortar: BASF's "EMACO S66 CI", Sika Corporation's "SikaRepair 223" or equal.

2.5 FABRICATION

A. Preparation:

1. Coordinate with other work supporting or adjoining miscellaneous metal and verify requirements of cutting out, fitting, and attaching.

2. Verify sizes, designs, and locations of items; do so at site whenever construction progress permits.

B. General Requirements

1. Fabricate items from materials noted and make true to profiles shown. Obtain Architect's approval of proposed variations.

2. Miter corners and angles of frames and moldings unless otherwise noted.

3. Perform cutting, shearing, drilling, punching, threading, tapping as required for items or their adjacent work.
4. Drill or punch holes; do not use cutting torch.
5. Ensure shearing and punching leaves true lines and surfaces.
6. Items to be Galvanized: Fabricate in accordance with recommended practices of ASTM A385 and A386 unless specifically noted otherwise.
7. Fabricate exterior items for assembly and installation on site without field-welding of joint.
8. Ensure metal thickness and assembly details provide ample strength and stiffness.
9. Size sleeves for approximately 1/4-inch clearance all around.

C. Fastening:

1. Provide fasteners and anchor assemblies required for complete fabrication, field assembly, and erection.
2. Conceal fastenings wherever practicable.
3. Size internally threaded diameters to accommodate galvanized threaded bolts where galvanizing is required.
4. Permanent connections in Ferrous Metal Items: Employ welding wherever practicable; avoid bolts and screws.

D. Welding:

1. Use electric shielded-arc process according to AWS D1.1 and AWS D1.3.
2. Maintain shape and profile of item welded.
3. Prevent heat blisters, run-throughs, and surface distortions.
4. Welds Normally Exposed to View in Finished Work: Make uniform and grind smooth.
5. Exposed Welds: Remove burrs, flux, welding oxide, air spots and discoloration; grind smooth, polish, or otherwise finish to match material welded.

2.6 FINISHES

A. Preparations of Surfaces:

1. Thoroughly clean mill scale, rust, dirt, grease, and other foreign matter from ferrous metal prior to galvanizing, hot phosphate treatment or painting.
2. Where hand cleaning methods are not adequate, clean in accordance with SSPC-SP 1, SSPC-SP 2, or SSPC-SP 7 as required.

3. Completely eliminate burrs, rough spots and pitting from normally exposed ferrous metal items.

B. Galvanizing:

1. Galvanize items after fabrication in largest sections practicable unless otherwise permitted or recommended by ASTM A384 and A385.

2. Where galvanizing is removed by welding or other assembly procedures, touch up abraded areas with molten zinc or zinc-rich paint.

3. Where ferrous metal item is noted to be galvanized, perform galvanizing in accordance with following standards as applicable to item:

a. Hardware items Including Fasteners: ASTM A153.

b. Other Fabricated items: ASTM A123.

C. Finish Schedule: Unless noted otherwise in Materials or Standard Catalog Products Articles.

1. Ferrous Metal, Interior Items:

a. Concealed: Clean, chemically etch, and shop-apply one prime-coat.

b. Exposed: Clean, treat with hot phosphate, chemically etch, and shop-apply one prime-coat.

2. Ferrous metal, Exterior Items:

a. Concealed: Clean and hot-dip galvanize in accordance with galvanizing standards.

b. Exposed: Clean, then hot-dip galvanize in accordance with galvanizing standards, chemically etch, and shop-apply one prime-coat.

3. Items Noted as Chrome-Plated: Same as US26D finish.

4. Hardware Including Fasteners (Bolts, Nuts, Washers, Etc.) and Anchors:

a. Finish to match items fastened or as shown. Furnish stainless steel expansion anchors at exterior locations and where indicated on Drawings.

b. Where galvanizing is required, hot-dip galvanize according to ASTM A153.

2.7 METAL FABRICATION ITEMS

A. Miscellaneous: Provide miscellaneous metal fabricated angles, channels, plates and shapes, threaded rods, pipe, bolts, nuts, washers, spacers, and fastenings shown or otherwise required to complete Work.

B. Fixed Ladders – Steel:

1. General: Fabricate each ladder to suit locations indicated on Drawings, in compliance with applicable provisions of NAAMM Metal Stairs Manual and requirements of CCR GISO, Section 3277.

2. Finish: Galvanized in compliance with Finishes article. Shop prime where painted finish is indicated on Drawings.

3. Rungs: Minimum 3/4” diameter solid steel bar, 12-inches on center; extend through side railings/stringers. Hold rungs at least 7 inches clear of wall and other obstruction construction.

   a. Non-Slip Surface: Provide on each rung. Coat top of rung with aluminum oxide set in an epoxy resin adhesive or provide a type of manufactured rung filled with aluminum oxide.

4. Side Railings / Stringers: Punch to receive rungs.

5. Safety Cage: Furnish in compliance with GISO on ladders exceeding 20 feet and where indicate on Drawings. Fabricate from galvanized steel bar sections, minimum 1/4 x 2-inches.

6. Anchorage: Furnish ladders with mounting brackets as shown on Drawings for anchoring to structure.

C. Standard Steel Pipe Railings and Handrails (Handgrips):

1. General: Fabricate railings and handrails to suit locations indicated on Drawings, in compliance with applicable provisions of NAAMM Pipe Railing Manual and California Building Code. Provide closed ends with return bends to walls, smooth bends, closed ends and welded connections with "Type 2" joint construction for appearance.

   a. Structural Requirements: Comply with CBC Section 1607A.7.1 for concentrated and uniform load resistances at post spacings and heights shown.

   b. Height: Guardrails shall be not less than 42 inches high, measured vertically above the adjacent walking surface or the line connecting the leading edges of stair treads, unless specifically shown otherwise on Drawings.

   c. Guardrail Accessibility Compliance: Guardrails shall not have openings between components and between sections of railings which allow passage of a sphere 4 inches in diameter, except where specifically indicated in the CBC.

   d. Handrail Accessibility Compliance: Handrail extensions beyond the top and bottom riser of stairs shall apply as required at all locations unless explicitly detailed otherwise on Drawings.

2. Top Rails, Posts and Handrails: 1-1/4 inch diameter minimum steel pipe or as indicated on drawings; welded joints.

3. Intermediate Rails: 1 inch diameter minimum steel pipe or as indicated on drawings; welded joints

4. Fittings: ADA-compliant cast wall brackets with suitable anchors for mounting to wall condition. Trimco’s “No. 3406” or equal.

5. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

6. Splice Connectors: Steel concealed spigots.

7. Finish: Refer to Finish Schedule article.

D. Bollards: ~~6-inch diameter steel pipe~~ **Cold-formed structural tubing (HSS)**, concrete-filled ~~with crowned cap~~, set in concrete footing.

1. Size: ~~6-inch diameter~~ **As indicated on Drawings**. Length as required by drawings, 36-inch minimum.

2. Finish: Galvanized. Prepare and paint exposed surface in accordance with Section 09 90 00 - Painting, color as directed by Architect.

3. Concrete Footing and Fill: 3,000 psi minimum compressive strength, as specified in Section 03 30 00 – Cast-In-Place Concrete.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas to receive work and verify that: Setting conditions and dimensions are correct to receive items.

B. Do not start installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install work plumb, true, rigid, and neatly trimmed out.

B. Do not tighten fastener through finish alone without spacer washers.

C. Provide concrete inserts or predrilled expansion bolts in fastening items into concrete. Install and tighten expansion anchors in accordance with manufacturer's recommendations and referenced Reports. Coordinate for inspection and testing as required. Clean and repair surfaces damaged by drilling or installation and fill abandoned holes with patching mortar in accordance with the manufacturer's instructions. Correction of defective work shall be the responsibility of the Contractor.

D. Protect dissimilar metals from contact with each other or with other materials causing corrosion.

E. Fasten work tightly to prevent rattle or vibration except where expansion-contraction tolerances are required.

F. Use non-shrink grout mixed in accordance with manufacturer's direction for setting frames, plates, sills, bolts and similar items.

G. Set items shown or required to be installed in sleeves with quick-setting anchor cement unless otherwise noted.

H. Protect metal from damage to surface, profile and shape.

3.3 CLEANING

A. Remove protective devices only when items will safe from other construction operations or removal is required to permit related work.

B. Touch up and clean prime-coated items as required for finish painting per Section 09 90 00.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes design and provision of steel frame of structural sections with closed stair risers; pan to receive ~~polished~~ **steel trowelled** concrete fill at interior stair and broom finish at exterior stair at stair treads and landings; integral guards and custom handrail.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements. (LEED v4.1)
2 Section 03 30 00 – Cast-In-Place Concrete.
3. Section 05 12 00 – Structural Steel
4. Section 05 31 00 – Steel Decking
5. Section 05 50 00 – Metal Fabrications.
6. Section 09 96 00 – High Performance Coatings.

1.2 REFERENCES

A. ASTM International:

1. ASTM A36 – Standard Specification for Carbon Structural Steel.
2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
6. ASTM A312 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
8. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
9. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

10. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
11. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
12. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
13. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
14. ASTM A786 - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
15. ASTM A992 - Standard Specification for Structural Steel Shapes.
16. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
17. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
18. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
19. ASTM F436 – Standard Specification for Hardened Steel Washers.
20. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

B. American Welding Society (AWS):

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 – Structural Welding Code – Steel

C. California Department of Health Services:

1. CA/DHS/EHLB/R-174 – Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

D. Green Seal:

1. GC-03 – Anti-Corrosive Paints.

E. National Association of Architectural Metal Manufacturers (NAAMM)

1. AMP 510 – Metal Stairs Manual.
2. AMP 521 – Pipe Railing Systems Manual.
3. MBG 531 – Metal Bar Grating Manual.

F. National Ornamental & Miscellaneous Metals Association (NOMMA)

1. NOMMA Guideline 1 – Joint Finishes.

G. The Society for Protective Coatings (SSPC)

1. SSPC - Steel Structures Painting Manual.
2. SSPC SP 1 – Solvent Cleaning.
3. SSPC SP 2 – Hand Tool Cleaning.
4. SSPC SP 10 – Near-White Blast Cleaning.
5. SSPC SP 15 – Steel Joist Shop Primer / Metal Building Primer.
6. SSPC Paint 20 – Zinc Rich Primers (Type I – Inorganic and Type II – Organic).

1.3. SUBMITTALS

A. Division 1 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
3. Indicate railing layout and dimensions, including splices and attachments.

C. Certificates

1. Welders' Certificates: Certify welders and welding procedures employed on the Work, verifying AWS qualification within previous 12 months.

D. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Recycled Content Materials: Furnish materials with maximum available recycled content.

E. Provide a copy of manufacturer data sheet or letter with percentages of pre and post-consumer recycled content, and provide materials cost

1.4 QUALITY ASSURANCE

A. Perform railing work according to ASTM E985.

B. Finish joints according to NOMMA Guideline 1.

C. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months for employed weld types.

D. Fabricator and Erector: Companies specializing in fabricating products specified in this Section with minimum five years' experience.

PART 2 – PRODUCTS

2.1 COMPONENTS

A. Steel W-Shapes: ASTM A992.

B. Steel T-Shapes: Cut from structural W-shapes

C. Steel Channels, Angles, and Tees: ASTM A36.

D. Round, Square and Rectangular Hollow Steel Sections: ASTM A500, Grade B or ASTM A501.

E. Steel Pipe: ASTM A53, Grade B.

F. Steel Plates: ASTM A53.

G. Floor Plates: ASTM A786; raised pattern.

H. Sheet Steel: ASTM A653, galvanized Grade 33 coating class.

I. Tread and Landing Concrete Reinforcement: Bar type.

J. Bolts: ASTM A307, Grade A.

K. Nuts: ASTM A563, heavy-hex type.

L. Washers: ASTM F844 for ASTM A307 bolts.

M. Shop Primer: SSPC Paint 15, Type 1, red oxide.

N. Touch Up Primer: Match shop prime; SSPC Paint 20 for Galvanized surfaces, ASTM A780.

O. Cast-in-Place Concrete: Type as specified in Section 03 30 00 – Cast-in-Place Concrete.

P. Polished Concrete filled Pan Treads at interior stair.

Q. Contrasting Nosing Strip: Basis of Specification: Wooster Products Inc, "Supergrit Type #630A" 3-inch wide by ¼"-inch deep Type 6063-T5 extruded aluminum base safety nosing with anti-slip aluminum oxide abrasive filler and sure-hold anchor for embedding in wet concrete. Abrasive Filler Color: Black (BLA-1).

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

2.3 FABRICATION

A. Fit and shop-assemble components in largest practical sections, for delivery to Site.

B. Fabricate components with joints tightly fitted and secured.

C. Continuously seal joined pieces by continuous welds.

D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish:

1. Exposed Surfaces: Finish #1.

2. Concealed Surfaces: Finish #3.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Accurately form components required for anchorage of stairs, landings and railings to each other and to building structure.

I. Pan Stairs and Landings:

1. Fabricate stairs and landings with closed risers and treads of metal pan construction, ready to receive concrete.

2. Form treads and risers in accordance with NAAMM Figure 7, with minimum 12-gage sheet steel stock.

3. Secure tread pans to stringers with clip angles welded in place.

4. Form stringers with rolled-steel channels, depth as required by Performance Requirements. Weld fascia plates to channels.

5. Form landings with sheet stock with reinforced underside to attain design load requirements.

6. Form guardrail balusters with steel sections indicated welded to stringers.

2.4 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 paint items with two coats.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Verification of existing conditions before starting work.

B. Verify that concealed blocking and reinforcement is installed and correctly located to receive wall-mounted handrails.

3.2 PREPARATION

A. Division 1 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Clean and strip primed steel items to bare metal where Site welding is required.

C. Supply items required to be cast into concrete and or embedded in masonry with setting templates.

D. Apply primer as required to prevent interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Install anchors, plates, angles, hangers or struts required for connecting stairs to structure.

C. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.

D. Field-weld components indicated on Shop Drawings. Perform field welding according to AWS D1.1.

E. Field-bolt and -weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

G. Obtain approval of Architect/Engineer prior to Site cutting or creating adjustments not scheduled.

H. After erection, prime welds, abrasions, and surfaces not galvanized, except surfaces to be in contact with concrete.

3.4 TOLERANCES

A. Maximum Variation from Plumb: 1/4-inch per story, noncumulative.

B. Maximum Offset from Alignment: 1/4-inch.

3.5 FIELD QUALITY CONTROL

A. Division 1 - Quality Requirements: Requirements for inspecting and testing.

B. Inspection: Inspect welds according to AWS D1.1.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes roof curbs, perimeter nailers; blocking in wall and roof openings; sleepers at floor-anchored casework; wood furring and grounds; telephone and electrical panel back boards; and preservative treatment of wood.

B. Related Sections:

1. Section 06 41 00 – Architectural Wood Casework.
2. Section 07 53 00 – Single Ply Roofing.

1.2 REFERENCES

A. American Wood-Preservers' Association:

1. AWPA C20 - Structural Lumber - Fire-Retardant Treatment by Pressure Process.
2. AWPA C27 – Plywood – Fire-Retardant Treatment by Pressure Process.
3. AWPA M4 - Standard for the Care of Preservative-Treated Wood Products.
4. AWPA U1 - Use Category System: User Specification for Treated Wood.

B. ASTM International:

1. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
4. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

C. California Department of Health Services:

1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

D. Forest Stewardship Council:

1. FSC Guidelines - Forest Stewardship Council Guidelines.

E. The Redwood Inspection Service:

1. RIS - Standard Specifications for Grades of California Redwood Lumber.

F. U.S. Department of Commerce National Institute of Standards and Technology:

1. DOC PS 1 - Construction and Industrial Plywood.
2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
3. DOC PS 20 - American Softwood Lumber Standard.

G. West Coast Lumber Inspection Bureau:

1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 SUBMITTALS

A. Product Data: Submit technical data on wood preservative and fire retardant treatment materials and application instructions.

B. Environmental Data: Certify products meet or exceed specified sustainable design requirements.

1. Certify lumber is harvested from Forest Stewardship Council Certified well managed forest.
2. Certify each composite wood product contains no added urea-formaldehyde resins.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the following:

1. Lumber Grading Agency: Certified by DOC PS 20.
2. Wood Structural Panel Grading Agency: APA - The Engineered Wood Association.
3. Lumber: DOC PS 20.
4. Wood Structural Panels: DOC PS 1 or DOC PS 2.

B. Surface Burning Characteristics:

1. Fire Retardant Treated Materials: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

C. Apply label from agency approved by authority having jurisdiction to identify each preservative treated and fire retardant treated material.

D. No particleboard is allowed.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Lumber Grading Rules: WCLIB.

B. Solid Wood Blocking and Framing: FSC-Certified, Stress Group 1, Douglas Fir species, Construction grade No. 3.

C. Plywood: APA PS 1-83, Grade C-C; Exterior. No added urea-formaldehyde resins.

2.2 ACCESSORIES

A. Fasteners and Anchors:

1. Fasteners: ASTM A153, hot dipped galvanized steel for high humidity, exterior, and treated wood locations, unfinished steel elsewhere.

2. Nails and Staples: ASTM F1667.

3. Anchors: Refer to Section 05 50 00 – Metal Fabrications.

2.3 FACTORY WOOD TREATMENT

A. Wood Preservative (Pressure Treatment): AWPA U1, Commodity Specification A-Sawn Products or F-Wood Composites using water-borne ACQ or SBX type preservative.

B. Fire Retardant Treatment: Chemically treated and pressure impregnated, having flame spread of 25 or less when tested in accordance with ASTM E 84 and showing no evidence of significant progressive combustion when test is continued for an additional 20 minute period, Interior Type.

C. Moisture Content after Treatment:

1. Lumber: Maximum 19 percent.

2. Structural Panels: Maximum 15 percent.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify substrate conditions are ready to receive blocking, curbing and framing.

3.2 PREPARATION

A. Coordinate placement of blocking, curbing and framing items.

3.3 INSTALLATION

A. Set members level and plumb, in correct position.

B. Place horizontal members, crown side up.

C. Construct curb members of solid wood sections.

D. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

E. Coordinate curb installation with installation of decking and support of deck openings.

F. Plywood: Gap joints 1/16 inch. Butt joints accurately at centerlines of supporting members..

G. Bolts and nuts: When installed, bear no more than 1/2-inch of threads on wood and allow no more than 1/2-inch of bolt to project beyond nut. Drill bolt holes 1/32-inch oversize. Tighten nuts snug when placed, and re-tighten at end of job or just before closing in.

3.4 SCHEDULE

A. Roof Blocking and Nailers: Specified solid lumber species, 19 percent maximum moisture content, pressure preservative treatment.

B. Sills or Plates on Concrete: Specified solid lumber species, 19 percent maximum moisture content, pressure preservative treatment. Set in grout if surface of concrete deviates from true plane by more than 1/16-inch in 4 feet. Anchor with bolts as shown. Use two bolts minimum per piece with one bolt located between 4 inches and 8 inches from each end of each piece of sill.

C. Telephone and Electrical Panel Boards: 3/4 inch thick Plywood, Class A Fire Retardant treated, square edges, painted to match walls per Section 09 90 00 – Painting and Coatings prior to installation of equipment.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes custom-fabricated plastic laminate faced cabinet units, cabinet hardware, countertops, preparation for installing utilities in cabinets and shop finishing.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 06 10 53 – Miscellaneous Rough Carpentry: Sleepers at floor-mounted casework.
3. Section 09 21 16 – Gypsum Board Assemblies: Provision of support framing and backing.
4. Section 09 65 00 – Resilient Flooring: Provision of resilient base.
5. Division 26 - Electrical: Electrical items integrated into casework.
6. Division 27 - Communications: Audio-visual system components integrated into casework.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI/BHMA A156.9 - Cabinet Hardware.
2. ANSI A208.1 - Mat-Formed Wood Particleboard.

B. American Society for Testing and Materials International (ASTM):

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E648 – Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

C. Federal Specification Unit:

1. FS A-A-1936 - Adhesive, Contact, Neoprene Rubber.
2. FS MMM-A-130 - Adhesive, Contact.

D. National Electrical Manufacturers Association (NEMA):

1. NEMA LD 3 - High Pressure Decorative Laminates.

E. National Fire Protection Association (NFPA):

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

2. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

F. Underwriters Laboratories Inc. (UL):

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

G. Woodwork Institute (WI):

1. NAAWS – North American Architectural Woodwork Standards, latest edition.

2. CCP – Certified Compliance Program.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

1. Show required locations for backing provided by contractor for anchorage of casework and countertops to building construction.

2. Shop drawings shall bear an individually-serial numbered WI Shop Drawing Certified Compliance Program label on cover page and each casework and/or countertop elevation.

C. Product Data: Submit data for hardware accessories and finishes.

D. Samples:

1. Submit two 8 x 10 inch size samples, illustrating all types of cabinet finish.

2. Submit two 8 x 10 inch size samples, illustrating all types of counter top finish.

3. Submit two samples of drawer pulls, hinges, and locks, illustrating hardware finish and style.

E. Certification: Submit WI Certified Compliance Program (CCP) certificates.

F. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Indoor Environmental Quality Certificates:

a. Certify volatile organic compound content for each interior sealant and adhesive.

b. Certify each composite wood product contains no added-urea formaldehyde resins.

G. All wood products to be FSC certified.

1.4 QUALITY ASSURANCE

A. Fabricator: Company shall be an Accredited Millwork Company (AMC) of the Woodwork Institute, authorized to provide WI Certified Compliance Program (CCP) certification.

B. Perform work in accordance with NAAWS Premium Grade except where modified elsewhere in this specification.

C. Perform work in compliance with WI Certified Compliance Program (CCP).

1. Before delivery to the job site, the supplier shall issue a CCP certificate or Certificate of Re-inspection indicating the products that will be furnished for this job and certifying that they will fully meet all the requirements of the grade or grades specified.

2. Each elevation of casework, each laminated plastic top, and each solid surface top shall bear a Woodwork Institute Certified Compliance Label.

3. At completion of installation, the woodwork installer shall provide a 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 its Certified Compliance Program are the responsibility of the millwork manufacturer and/or installer and shall be included in their bid.

D. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.5 REGULATORY REQUIREMENTS

A. Comply with Bay Area Air Quality Management District Regulation 8:

1. Rule 23: Coating of Flat Wood Paneling and Wood Flat Stock.

2. Rule 32: Wood Products Coatings.

3. Rule 51: Adhesive and Sealant Products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Product storage and handling requirements.

B. Do not deliver casework products until an area is provided for storage that is enclosed, all wet work dry, and broom clean.

C. Protect products from direct sunlight. Maintain relative humidity between 45 and 65 percent. Maintain ambient temperature between 68 and 98 degrees F.

D. Allow products to acclimate to building conditions for minimum 72 hours before installation. Inspect for damage.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Division 1 - Product Requirements.

B. Maintain storage space relative humidity within ranges indicated in NAAWS Section 2.

C. During and after installation of Work of this section, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

A. In addition to the warranty and correction of work requirements of the General Conditions, work under this Section shall be free of defects including but not limited to delamination, door or drawer warpage exceeding NAAWS standards for a period of two years from date of "Notice of Completion." Written guarantee signed by the cabinet manufacturer and the Contractor shall include all materials and labor required to make necessary repairs or replacement and make good any damage to other work caused by such repair or replacement.

PART 2 – PRODUCTS

2.1 COMPONENTS

A. Medium Density Fiberboard (MDF): ANSI A208.2; industrial grade, composed of randomly oriented wood fibers and resin, hot pressed.

1. Formaldehyde Free and Fire Retardant Treated MDF: Urea-formaldehyde free, Class A fire retardant, Forest Stewardship Council certified; Panel Source International “Pyroblock FSC Certified Particleboard and MDF”.

B. Lumber: Douglas fir; No. 3 or construction grade per WCLIB. Provide pressure-treated for moisture resistance at floor sleepers.

C. High Pressure Decorative Laminate:

1. Plastic Laminate: ASTM E84; Class A, NEMA LD 3, GP50 for horizontal surfaces, GP28 for vertical surfaces, CL20 for cabinet liner surfaces, BK20 for undecorated backing sheets, PF42 for post forming, FR50 for fire-retardant surfaces; surface texture as selected.

2. Manufacturer, Color and Pattern: No substitutions.

a. As indicated on finish schedule.

D. Countertops:

1. As indicated on finish schedule.

2. Subtops: Plywood as specified in Section 06 10 53, 5/8-inch thick or as indicated on Drawings.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Certified Wood Materials: Furnish wood materials certified in accordance with guidelines referenced in Section 01 81 13.

C. Indoor Environmental Quality Characteristics:

1. Adhesives and Sealants: Maximum volatile organic compound content in accordance with Section 01 81 13.

2. Composite Wood Products: Emissions content in accordance with Section 01 81 13.

2.3 ACCESSORIES

A. Adhesive for High Pressure Decorative Laminates and Surfacing Facings: Formaldehyde free types. Type recommended by facing manufacturer to suit application.

B. Painter's Caulk and Sanitary Sealant: Refer to Section 07 90 00.

C. Plastic Laminate Edge Band: 0.050-inch thick plastic laminate edge band matching face veneer.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application and as shown; plain finish in concealed locations and plated finish in exposed locations except otherwise indicated.

E. Concealed Joint Fasteners: Threaded steel.

F. Drawer and Door Pulls: 2-7/8" long wire pull with satin stainless finish, DP57A by Doug Mockett.

G. Drawer Slides: 100 pounds load rating for drawers less than 24 inches wide and 150 pounds for drawers more than 24 inches wide, galvanized steel construction, ball bearings separating tracks, full extension type. Accuride, Grant/Hettich, or accepted equal.

H. Hinges: European style, all-metal construction, 170-degree minimum opening, controlled-self-closing hinges. Blum's Clip 170 hinge with Blumotion, or equal.

I. Shelf support:

1. Casework Prep: Provide 2 rows of 5mm diameter holes, full height in every case shown to have adjustable shelves. Center holes at spacing compatible with supports. Provide 4 supports per shelf.

2. Wood and Solid Phenolic Shelf Supports: Clear plastic lock down supports suitable for ¾-inch and 1-inch thick shelves. Double 5 mm pins @ 32 mm centers. Haefele 282.47.402, Bainbridge No. 3220, or equal.

3. Glass Shelf Support: Nickel-plated zinc alloy clamp with transparent plastic glass rest and 5 mm pin suitable for up to ½-inch thick shelves. Haefele 282.13.712 or equal.

J. Catches: Screw mount magnet, black plastic, steel strike. Holding power: 4-5 kg. Haefele 246.29.301.

K. Cabinet Locks: Re-keyable via set screw cylinder release; solid brass pin tumbler cylinder drilled for 5 pins; US26D finish; National Keyway, master keyed, 5 pin standard. Drawers / Doors: Olympus Lock, Incorporated's 200DW / 100DR or equal.

2.4 FABRICATION

A. General Requirements:

1. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.

2. When necessary to cut and fit on Site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.

3. Mechanically fasten back splash to counter tops with steel brackets at 16 inches on center.

4. Fabricate cabinets and counter tops with cutouts for plumbing fixtures and trims, inserts, appliances, outlet boxes, fixtures and fittings, and toilet accessories. Verify locations of cutouts from on-site dimensions. Seal cut edges.

B. Plastic Laminate Cabinets:

1. Fabricate cabinets in compliance with NAAWS Section 10 Casework: Custom Grade. Construction shall be Type I Style A frameless. Door and drawer front style shall be flush overlay.

2. Door Style: Flush Type A.

3. Door, Drawer Fronts, Slope Tops, and Closure Panels: 3/4 inch thick.

4. Shelves: 3/4 inch thickness less than 2 feet 6 inches span. 1 inch thickness for 2 feet 6 inches and longer span.

5. Plastic Laminate: High pressure plastic laminate unless otherwise indicated.

a. Apply high pressure decorative laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.

b. Fit shelves, doors, and exposed edges with nominal matching plastic laminate edging. Use one piece for full length only.

c. Semi-exposed surfaces: Grade CL20 light color high pressure plastic laminate cabinet liner nominal 0.020-inch thickness; except visible surfaces, open cabinet shall be same as exposed exterior surfaces.

d. Interior exposed shelf edges shall be self-edged with matching plastic laminate.

e. Doors shall have same material both sides.

C. Solid Surface Countertops:

1. Fabricate countertops in accordance with recommendations of NAAWS Section 11 Premium grade.

2. Apply full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.

3. Thickness: As specified and shown.

4. Fabricate with eased edge.

5. Provide 4-inch high square splash with scribe allowance unless otherwise shown and scribe to wall. Include return splashes for end walls.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Coordination and project conditions.

B. Verify dimensions at site.

C. Verify adequacy of backing and support framing.

D. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

A. Install casework in accord with NAAWS Sections 10 and 11 except as otherwise shown or specified.

B. Set and secure casework in place; rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units and counter tops.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. Secure cabinet and counter bases to floor using appropriate angles and anchorages.

G. Install base finish indicated on Drawings and specified elsewhere at toe kicks and as shown.

H. Countertops:

1. Run counter continuous over base cabinets, equipment and spaces as shown.

2. Provide splash at end where top is adjacent to wall or any equipment, fixed or movable, unless otherwise shown.

3. Scribe to wall or other adjacent materials leaving a gap of 1/16-inch minimum. Use Painter's Caulk or Sanitary Sealant of an approved color to seal gaps.

4. Apply finish top and splash in full uninterrupted sheets with no splices unless run exceeds maximum limits of material. Use draw-bolt tight joint fasteners at all splice joints. Where run exceeds maximum limits of material use no piece less than 3 feet in length. Corners and joints: hairline. Locate counter butt joint, if required, at least 2 feet from sink cutouts.

3.3 ADJUSTING

A. Division 1 - Execution and Closeout Requirements: Testing, adjusting and balancing.

B. Adjust moving or operating parts to function smoothly and correctly.

3.4 FIELD QUALITY CONTROL

A. Inspection: Furnish third party inspection in compliance with NAAWS CCP and CSIP. Furnish Architect with copies of all reports conducted.

3.5 CLEANING

A. Division 1 - Execution and Closeout Requirements: Final cleaning.

B. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:

1. Positive-side, below grade sheet membrane waterproofing (pre-applied "blindside" and/or post-applied) to vertical walls, related accessories including drainage panel, protective cover and perforated drainage piping; coordination with other waterproofing systems where they intersect.

2. Pre-applied, blindside sheet membrane waterproofing below slabs on-grade at locations indicated.

~~3. Waterproofing membrane for elevated plaza deck, located beneath plaza paver systems.~~

B. Related Sections:

1. Section 03 30 00 – Cast In Place Concrete.

2. Section 07 26 00 – Vapor Retarders: Tie-in of sheet waterproofing with below-slab vapor retarders.

3. Section 07 62 00 – Sheet Metal Flashing and Trim: Coordination with perimeter flashing components.

4. Section 07 76 00 – Plaza Paver Systems: Provision of waterproofing membrane and protection course below paver systems.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

2. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.

3. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

4. ASTM D822 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

5. ASTM D5957 - Standard Guide for Flood Testing Horizontal Waterproofing Installations.

6. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SYSTEM DESCRIPTION

A. Waterproofing Systems:

1. Comply with local regulatory restrictions for Volatile Organic Compounds (VOC).
2. Prevent water or moisture migration to interior.
3. Protect surfaces noted against permeation by water from above grade.
4. Compatible with related waterproofing systems.
5. Furnish products of, or accepted by, single manufacturer for each system type furnished.

1.4 SUBMITTALS

A. Comply with Division 1 – Submittal Procedures.

B. Product Data. Include manufacturer's written instructions for evaluating, preparing and treating substrate, installation instructions, technical data and tested physical and performance properties of materials.

C. Certification that manufacturer and installer meet requirements of QUALITY CONTROL article in this Section.

D. Certification by manufacturer's representative accepting the proposed use of waterproofing materials and methods as specified under Jobsite Meeting.

E. Submit copy of manufacturer's technical representative's field inspection reports on installation and water test inspection of sheet membrane waterproofing.

F. Warranties: Special warranties specified in this Section.

1.5 QUALITY CONTROL

A. Comply with Division 1 – Quality Control.

B. Single Responsibility: Obtain waterproofing materials and accessory items through one source from a single manufacturer. Work shall be performed by single installer having undivided responsibility for providing complete work, including all components and related work, and for performance and quality of waterproofing.

C. Acceptance is required of products of service, of proposed manufacturer and installer, and will be based upon submission of certification that:

1. Manufacturer regularly and presently manufactures sheet membrane waterproofing as one of manufacturer's principal products.
2. Manufacturer's product submitted has been in satisfactory and efficient use on three installations similar or equivalent to this project for three years. Submit list

of installations. List shall include name and location of project and name of owner.

3. Installer has had a minimum of five years successful experience in applying sheet membrane waterproofing.

4. Installer has been licensed or approved by sheet membrane waterproofing manufacturer, and certified by the manufacturer as having the necessary expertise to install the specified system.

D. Contractor shall arrange for manufacturer's technical representative to be on Site to advise installer of proper procedures and precautions for use of materials and to review installation.

1.6 PRE-INSTALLATION MEETINGS:

A. Required Conferences:

1. Contractor-Installer-Manufacturer Review: Contractor and installer shall review Drawings and Specifications with representative of waterproofing materials manufacturer and obtain manufacture's agreement that selected systems are proper, compatible, and adequate for application shown and that conditions and details do not conflict with manufacturer's warranty/guaranty.

2. Pre-Application Conference: Contractor shall arrange conference to review waterproofing work prior to actual installation.

a. Conference to be attended by Owner, Consultants, Contractor, and Installer, authorized representatives of accepted manufacturer, and other installers whose work may be affected by quality of waterproofing. Contractor to provide at least one week's advance notice of conference date and time.

b. Conference shall be held at Site and shall be conducted with accepted submittal and prior to delivering any material to Site.

c. Following major considerations shall be reviewed at conference:

i. Review in detail surface preparation, protection of adjacent surfaces, installation procedures, field quality control, and other related items.

ii. Review in detail project conditions, schedule, construction sequence, application requirements, and quality of completed installation.

iii. Review methods for storing and handling materials.

iv. Review in detail means of protecting completed work during remainder of construction period.

v. Record discussions of conference and any conflict, incompatibility, or inadequacy, and furnish a copy of record to each participant.

vi. Meeting notes of this conference will be produced by Contractor that will record discussions of conference and any conflict, incompatibility, or inadequacy and they will indicate that installer of waterproofing

has reviewed and accepted substrates for waterproofing. Distribute meeting notes to attendees prior to installation of waterproofing.

vii. Flood testing.

1.7 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. Discharge materials carefully and store on clean concrete surface or raised platform in safe, dry area at temperatures above 40 and below 75 degrees F. Do not dump onto ground.

C. Remove and replace materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions and protect materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Requirements: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog or mist.

2. Apply waterproofing within range of ambient and substrate temperatures recommended by manufacturer.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.9 SCHEDULING

A. Schedule work such that membrane will not be left exposed to weather for longer than time period recommended by manufacturer.

B. Schedule installation immediately prior to installation of wearing surfaces.

1.10 WARRANTY

A. Manufacturer Warranty: Warrant sheet waterproofing system, including related and integral flashings, watertight and weather-tight for period of 10 years from Substantial Completion.

B. Contractor Warranty: Furnish a two year written performance warranty, countersigned by the waterproofing installer that the installed systems shall not deteriorate or fail to perform as a result of workmanship.

PART 2 – PRODUCTS

2.1 SHEET WATERPROOFING

A. Manufacturers: Furnish products of one of the following or approved equal:

1. Grace Construction Products
2. Polyguard Products

B. System Description: Waterproofing membrane products for blind-side and/or post-applied applications. Component products and Accessories identified below are products of Grace Construction for clarification of specification basis.

2.2 COMPONENTS

A. Post-Applied Sheet Waterproofing Membrane: Self-adhesive, cold-applied, composite HDPE membrane; minimum 1.5mm (0.056 inch) thick; black color; conforming to following criteria:

Properties	Test	Results
Tensile Strength, Membrane	ASTM D412	2240 kPa (325 lbs/in2) minimum
Elongation, Rubberized Asphalt Ultimate Failure	ASTM D412	300% minimum
Puncture Resistance, Membrane	ASTM E154	222N (50 lbs) minimum
Peel Strength	ASTM D903	1576 N/m (9 lbs/in) minimum
Water Absorption	ASTM D570	0.1% maximum
Water Vapor Permeance (perms)	ASTM E96 Water Method	2.9 ng/m2sPa (0.05 perms) maximum
Resistance to Hydrostatic Head	ASTM D5385	70 m (210 ft) water

1. Design Basis Product: “Bituthene 4000”

B. Below-Slab, Blind-Side Waterproofing Membrane: Pressure-sensitive self-adhering, blind-side composite HDPE membrane with protective release liner; minimum 1.2mm thick; conforming to following criteria:

Properties	Test	Results
Tensile Strength, Membrane	ASTM D412	4000 psi minimum
Elongation, Rubberized Asphalt Ultimate Failure	ASTM D412	500% minimum
Puncture Resistance, Membrane	ASTM E154	220 lbs minimum
Peel Strength	ASTM D903	5 lbs/inch minimum
Water Absorption	ASTM D570	0.5% maximum
Water Vapor Permeance (perms)	ASTM E96 Water Method	0.01 perms maximum
Resistance to Hydrostatic Head	ASTM D5385	230 feet water minimum

1. Basis of Specification: “Preprufe 300R **Plus**”.

2. Pre-formed Corners: Furnish for all inside and outside corners, including slab-edge upturns.

2.3 ACCESSORIES

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

B. Drainage Panel / Protection Course:

1. Vertical Applications: Provide sheet membrane manufacturer’s standard or recommended product. Minimum 9.5 mm (0.375 inch) thick composite drainage sheet system with hollow core protected with filter fabric cover sheet. Design Basis Product: “Hydroduct 220”.

2. Horizontal Applications: Provide sheet membrane manufacturer’s standard or recommended high impact product. Minimum 9.5 mm (0.375 inch) thick composite drainage sheet system with hollow core protected with filter fabric cover sheet. Minimum compressive strength: 18,000 lbs/ft2. Design Basis Product: “Hydroduct 660”.

C. Primer (Surface Conditioner): Sheet membrane manufacturer’s water-based latex standard or recommended product to bind site dust and concrete efflorescence. Shall dry quickly and slightly tacky. Design Basis Product: “Bituthene Primer B2 LVC".

D. Deck Preparation: Sheet membrane manufacturer’s recommended deck levelling and repair material for elevated plaza decks. Design Basis Product: “Bituthene Deck Prep”.

E. Liquid Membrane: Two component, elastomeric, cold-applied trowel-grade material. Grace Construction Products’ “Bituthene Liquid Membrane” as required for Grace system.

F. Sheet Strips: Self-adhering, rubberized asphalt sheet strips of same material and thickness as waterproofing.

G. Metal Termination Bars: Manufacturer’s standard pre-punched extruded aluminum bars, or, aluminum bars approximately 1- by 1/8-inch thick, predrilled holes at 9-inch centers.

H. Fasteners: Waterproofing manufacturer’s standard fasteners or as recommended by waterproofing manufacturer.

I. Perforated Drainage Piping: Perforated corrugated high density polyethylene tubing for sub-drainage applications, meets or exceeds requirements of ASTM D1248 Type III, Category 4 or 5, Grade P33 or P34, Class C, 4-inches diameter. Oxford Plastics Inc.; ADS; or accepted equal.

J. Geotextile (Filter Fabric): Polyolefin or polyester fabric, non-woven, formed into sock or sleeve, water pervious type. TenCate's "Mirifi 140N"; Carriff Engineered Fabrics' "Drain Sleeve Filter"; or accepted equal.

PART 3 – EXECUTION

3.1 EXAMINATION

A. General: Inspect and remove from surfaces to receive waterproofing all dirt, debris, grease, oil, form releasing agents, paints and other penetrating contaminants. Verify that penetrations and projections through the substrate have been installed. Remove fins, ridges, mortars and other projections and fill honeycomb, aggregate pockets, and other voids, and verify that concrete substrate and patches have cured a sufficient length of time in accordance with membrane manufacturer's recommendations but in no case less than seven days.

B. Satisfactory Conditions: Do not commence installation until conditions are satisfactory to manufacturer of primary waterproofing membrane, as certified in writing. Start installation only in presence of manufacturer's representative.

3.2 PREPARATION – POST-APPLIED SHEET WATERPROOFING

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat voids, joints and cracks in substrates as recommended by sheet membrane waterproofing manufacturer. Remove dust and dirt from joints and cracks according to ASTM D4258.

1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding width of 1/16-inch as instructed by sheet membrane manufacturer.

F. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D6135.

G. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D6135.

3.3 POST-APPLIED SHEET WATERPROOFING MEMBRANE INSTALLATION

A. General: Comply with specifications and installation instructions in manufacturer's published literature.

1. Install two complete layers of sheet waterproofing at elevated decks with plaza paver systems located over interior space below. Waterproofing membranes shall be installed over deck preparation product applied directly to concrete or plywood substrate.

B. Prime concrete surfaces immediately prior to application of tapes and pressure sensitive waterproofing accessories. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Re-prime areas exposed for more than 24 hours.

C. Install self-adhering sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D6135.

D. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 6-inch minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25- and 40- degrees F, install self-adhering, rubberized-asphalt sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60-degrees F.

2. Seal all laps with Liquid Membrane.

3. Hand roll all laps and strips to ensure full adhesion.

E. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.

F. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic or sealant.

G. Install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing. Use pre-formed corners at blind-side slab edges and furnish adequate upturn for 6 inch lap of positive-side membrane material.

H. Terminate top edge of membrane with termination bar.

1. At fasteners installed to concrete, pre-drill fastener penetrations to minimize spalling at substrate.

2. Fasten at 9-inch on center with accepted fasteners.

3. Coat top edge and termination bar with 90-mil application of liquid membrane. **Coordinate tie-ins to assemblies above as detailed in Drawings.**

I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheets extending 6 inches beyond repaired areas in all directions.

J. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements, repair substrates, reapply waterproofing, and repair sheet flashings.

K. Projection Treatment: Apply liquid membrane and 9-inch detail sheet around pipes and similar projections at least 2-1/2 inches in all directions.

L. Penetrations: Cut holes to fit tightly around penetrations and apply collar flashing.

M. Protrusions: Apply two layers of membrane around protrusions and drains at least 6 inches in all directions and seal with mastic.

N. Repair tears, punctures, air blisters, and inadequately lapped seams, in accordance with the manufacturer's instructions before or protection board is applied.

1. Damage or Puncture of Modified Bituminous Sheet Membrane: Install patch of short membrane set in liquid membrane. Patch must extend 3-inches in every direction around extent of damaged area. Install waterproofing tape centered over edge of the patch. If damaged areas does not have 5-inches of sound material around it, inject liquid membrane into puncture until liquid membrane backs out, and proceed with patch as space allows.

2. Scratch on White Coating Exposing Underlying Black Surfacing of Sheet Membrane: Install waterproofing tape at areas where white coating of membrane is damaged, including boot scuff marks and abrasion by rebar.

O. Install composite drainage panel / protection course over vertical and horizontal waterproofing membrane applications per manufacturer's directions. Do not install until after successful flood testing specified in Field Quality Control, where required.

3.4 PRE-APPLIED BELOW SLAB SHEET WATERPROOFING INSTALLATION

A. General: Comply with specifications and installation instructions in manufacturer's published literature.

B. Examine substrate to ensure that it is sound so as to eliminate movement during concrete placement. Remove any standing water and eliminate sharp protrusions and loose aggregate.

C. Place the membrane with HDPE film side to the substrate. Stagger end laps to avoid build-up and leave plastic release liner in place until overlap procedure is completed.

D. Lap the previous sheet 3 inches along marked selvedge. Do not lap sheets unless underside of the succeeding sheet is clean, dry and free from contamination. Peel back release liner between the overlap as the two layers are bonded together. Ensure a continuous bond is achieved without creases and roll firmly with heavy roller.

E. Completely remove liner to expose the protective coating.

F. Penetrations: Grout around the penetrant if not stable. Scribe membrane tight to the penetrant. Apply manufacturer's detailing tape to cover gaps exceeding 1/4-inch. Apply Liquid Membrane around the penetration using a fillet to provide a watertight seal between membrane and tape. Remove any liner from the tape.

G. Perimeters: Install membrane beyond perimeter of slab and/or footings to leave "tail" with length adequate to permit a minimum of 6-inch overlap at tie-in with post-applied vertical waterproofing system per Drawings and manufacturer's standard recommendations.

H. Repair damaged areas by wiping clean with a damp cloth and and allowing to dry prior to installing manufacturer's detailing tape. Remove any liner from the tape.

3.5 PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protection installed membrane, drainage panels and protection boards from damage due to UV light, harmful weather exposure, physical abuse and other causes. Provide temporary coverings where material will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer for affected construction.

3.6 FIELD QUALITY CONTROL

A. Contractor shall provide all inspections required from the manufacturer for the specified warranty. Engage full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; membrane application, flashings, protection, and drainage components; and to furnish daily reports to Contractor and Owner.

~~B. Horizontal Post-Applied Sheet Waterproofing Membrane Testing: Furnish flood test, in conformance with ASTM D5957, of each installation of waterproofing assembly located over habitable space for leaks after waterproofing installation and before protection course and overlaying construction are installed. Plug or dam drains and fill with water to a depth of 2-inches across entire area. Keep separate container of water to similar depth nearby to establish evaporation rates. Flood each area for 48 hours.~~

~~1. Correct deficiencies as specified herein and re-test plaza deck areas at no additional cost to Owner as necessary to determine compliance with requirements for a watertight assembly.~~

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY:

A. Section includes polyurethane waterproofing for rooftop equipment pads and where otherwise indicated.

B. Related Sections:

1. Section 03 30 00 – Cast-in-Place Concrete.
2. Section 07 18 00 – Traffic Coatings.
3. Section 07 54 23 – Thermoplastic Polyolefin Roofing.
4. Section 07 62 00 – Sheet Metal Flashing and Trim.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C836 – Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
2. ASTM C898 - Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane With Separate Wearing Course.
3. ASTM C1127 – Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface.
4. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.
5. ASTM D4259 - Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application
6. ASTM E108 – Standard Test Methods for Fire Tests of Roof Coverings.

B. Cool Roof Rating Council (CRRC)

1. CRRC-1 – Roof Product Rating Manual.

C. South Coast Air Quality Management District:

1. SCAQMD Rule 1113 – Architectural Coatings

1.3 SUBMITTALS:

A. Product Data for each product specified, to include installation instructions and details, tested physical and performance properties of waterproofing, dry- or wet-film thickness requirements, and finish.

B. Shop Drawings to include details for treating any substrate joints and cracks, sheet flashings, penetrations, corner conditions, tie-ins with adjoining waterproofing and/or roofing, and other termination conditions.

C. Qualification Data for manufacturer-authorized installer.

D. Field Quality Control inspection report.

E. Maintenance Data: For waterproofing to include in maintenance manual.

1.4 PERFORMANCE CRITERIA

A. Fire-Test-Response Characteristics: ASTM E108, Class A.

B. Roofing System Design: Provide membrane roofing system identical to systems that have been successfully testing by a qualified testing and inspection agency to resist uplift pressure calculated according to ASCE / SEI 7.

C. Energy Performance: Provide waterproofing with an initial Solar Reflectance Index of not less than 0.70 and emissivity of not less than 0.75 when tested according to CRRC-1

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 ENVIRONMENTAL CONDITIONS:

A. Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by manufacturer. Regardless of those recommendations, do not apply waterproofing to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply waterproofing in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.7 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within Ten years from date of Substantial Completion. Failures include, but are not limited to:

PART 2 – PRODUCTS

2.1 POLYURETHANE WATERPROOFING

A. Manufacturers: Provide compliant products of one of the following or approved equal:

1. Johns Manville Corporation.
2. Kemper System America Inc.
3. Siplast.

B. System Description: ASTM C836; VOC-compliant, polymethyl methacrylate (PMMA) waterproofing membrane, two-component composed of catalyst and fleece reinforcement layer with a collective dry-film thickness of 80 mil. Basis of the Specification: Johns Manville's "JM PMMA".

2.2 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

B. Primer: Liquid primer, sealer or surface conditioner as recommended in writing for substrate and conditions by waterproofing manufacturer.

C. Membrane: Manufacturer's cold fluid-applied reactive cure polyurethane resin.

D. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric, manufacturer's standard weight.

E. Membrane Flashings: A composite of the same resin material as field membrane with fleece reinforcement, 90 mil dry-film thickness.

F. PMMA Surfacing and Color Finish: For use with PMMA membrane systems in combination with catalyst to form a resilient finish top coat. Finish Color: Manufacturer's standard Light Gray.

2.3 ACCESSORY MATERIALS

A. Transition membrane: Foil-faced separator as specified in roofing membrane Section.

PART 3 – EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, surface smoothness, and other conditions affecting performance of waterproofing work.

B. Verify that substrates are visibly dry and free of moisture.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Begin waterproofing application only after substrate construction and penetrating work have been completed.

2. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by waterproofing manufacturer has passed and after substrates are dry.

3. Application of waterproofing indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. If concrete substrate surface texture does no comply with waterproofing manufacturer's requirements, mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D4259. Do not acid etch.

B. Clean and prepare substrates according to ASTM C1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.

C. Priming: Unless manufacturer recommends in writing against priming, prime substrates according to manufacturer's written instructions.

1. Limit priming to areas that will be covered by traffic-coating material on same day. Reprime areas exposed for more time than recommended by manufacturer.

D. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.

E. Mask adjoining surfaces not receiving waterproofing to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C898 and manufacturer's written instructions.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C898 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258. Comply with recommendations in ASTM C1193 for joint-sealant installation.

B. Terminate edges of any deck-to-deck expansion joints with joint reinforcing strip with first preparation coat.

3.5 WATERPROOFING INSTALLATION

A. Apply waterproofing according to ASTM C898 and manufacturer's written instructions.

B. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

C. Mix materials and apply waterproofing by roller, notched squeegee, trowel, or other suitable application method.

1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness of 80 mils.

2. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.

3. Verify that wet-film thickness of each coat complies with requirements every 100 sq ft.

D. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

E. Uniformly broadcast and embed aggregate in each coat indicated to receive aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform Electronic Leak-Detection Testing:

1. Testing agency must test each waterproofed area for leaks using an electronic leak-detection method that locates discontinuities in the waterproofing membrane.

2. Testing agency must perform tests on abutting or overlapping smaller areas as necessary to cover entire test area.

3. Testing agency must create a conductive electronic field over the area of waterproofing to be tested and electronically determine locations of discontinuities or leaks, if any, in the waterproofing.

4. Testing agency must provide survey report indicating locations of discontinuities, if any.

B. Final Traffic-Coating Inspection: Arrange for waterproofing manufacturer's technical personnel to inspect membrane installation on completion. Notify Architect or Owner 48 hours in advance of date and time of inspection.

C. Waterproofing will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports for submittal.

3.7 PROTECTION AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

1. Install protection course with butted joints over waterproofing before starting subsequent construction operations.

2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY:

A. Section includes waterproof traffic coatings for pedestrian traffic where indicated for exterior balconies.

B. Related Sections:

1. Division 3 – Cast-in-Place Concrete: Concrete substrates.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C957 – Standard Specification for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane With Integral Wearing Surface.

2. ASTM C1127 – Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface.

3. ASTM C1193 - Standard Guide for Use of Joint Sealants.

4. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.

5. ASTM D4259 - Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application

6. ASTM E108 – Standard Test Methods for Fire Tests of Roof Coverings.

B. Cool Roof Rating Council (CRRC)

1. CRRC-1 – Roof Product Rating Manual.

C. South Coast Air Quality Management District:

1. SCAQMD Rule 1113 – Architectural Coatings

1.3 SUBMITTALS:

A. Product Data for each project specified, to include installation instructions and details, material descriptions, dry- or wet-film thickness requirements, and finish.

B. Shop Drawings to include details for treating any substrate joints and cracks, flashings, deck penetrations, and other termination conditions that are not included in manufacturer's product data.

C. Samples for selection of each type of exposed finish from manufacturer’s standard.

D. Qualification Data for manufacturer-authorized installer.

E. Field Quality Control inspection report.

F. Maintenance Data: For traffic coatings to include in maintenance manual.

1.3 PERFORMANCE CRITERIA

A. Fire-Test-Response Characteristics: ASTM E108, Class A.

B. Energy Performance: Provide traffic coating with an initial Solar Reflectance Index of not less than 0.70 and emissivity of not less than 0.75 when tested according to CRRC-1

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Source Limitation: Obtain traffic coating systems from single source and from single manufacturer, except where manufacturer recommends use of alternate sources.

C. Material Compatibility: Provide primers; base coat, intermediate coat, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

D. Mockups: Build mockups to set quality standards for materials and execution.

1. Build mockup for each traffic coating and substrate to receive traffic coatings.

2. Size: Minimum 100 sq. ft. of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.

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.

1.5 ENVIRONMENTAL CONDITIONS:

A. Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Regardless of those recommendations, do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.

B. Do not install traffic coating until items that penetrate membrane have been installed.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within Five years from date of Substantial Completion. Failures include, but are not limited to:

1. Adhesive or cohesive failures.

2. Abrasion or tearing failures.

3. Surface crazing or spalling.

4. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.

PART 2 – PRODUCTS

2.1 PEDESTRIAN TRAFFIC COATINGS

A. Manufacturers: Provide compliant products of one of the following or approved equal:

1. Hempel / Neogard.

2. Sika Corporation.

3. Tremco Construction Products Group.

B. Product Description: ASTM C957-compliant, standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, water-resistant membrane system with integral wearing surface for pedestrian traffic service condition. Components of Neogard's "Peda-Gard FC" system are listed below the Basis of the Specification.

2.2 COMPONENTS

A. Primer: Liquid primer as recommended in writing for substrate and conditions by traffic-coating manufacturer.

B. Base Coat: Two-component, fast cure polyurethane base coat, compliant with SCAQMD VOC criteria. Neogard's "FC7500/FC7960".

1. Thickness: Minimum dry- and wet-film thickness as recommended in writing by manufacturer for substrate and service conditions indicated.

C. Intermediate / Wear Coat: Two-component, fast cure aromatic urethane intermediate coat, compliant with SCAQMD VOC criteria, with embedded aggregate. Neogard's "FC7510/FC7961".

1. Thickness: Minimum dry- and wet-film thickness as recommended in writing by manufacturer for substrate and service conditions indicated. Measurement shall exclude aggregate.

2. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated.

D. Topcoat: Two-component, fast cure aromatic urethane with UV inhibitors, compliant with SCAQMD VOC criteria. Neogard's "FC7540/FC7964"

1. Thickness: Minimum dry- and wet-film thickness as recommended in writing by manufacturer for substrate and service conditions indicated.

2. Color: As selected by Architect from manufacturer's full range of standard options.

E. Aggregate: Manufacturer's standard aggregate for each use indicated, consisting of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer

2.3 ACCESSORY MATERIALS

A. Joint Sealants: Manufacturer's recommended urethane sealant, color as selected by Architect.

B. Sheet Flashing: Nonstaining sheet material recommended in writing by traffic-coating manufacturer.

C. Adhesive: Contact adhesive recommended in writing by traffic-coating manufacturer.

D. Reinforcing Fabric: Fiberglass mesh recommended in writing by traffic-coating manufacturer.

PART 3 – EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, surface smoothness, and other conditions affecting performance of traffic-coating work.

B. Verify that substrates are visibly dry and free of moisture.

1. Test for moisture content by method recommended in writing by traffic-coating manufacturer.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Begin coating application only after substrate construction and penetrating work have been completed.

2. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.

3. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. If concrete substrate surface texture does not traffic coating manufacturer's requirements, mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D4259. Do not acid etch.

B. Clean and prepare substrates according to ASTM C1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.

C. Priming: Unless manufacturer recommends in writing against priming, prime substrates according to manufacturer's written instructions.

1. Limit priming to areas that will be covered by traffic-coating material on same day. Reprime areas exposed for more time than recommended by manufacturer.

D. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.

E. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C1127 and manufacturer's written instructions.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.

C. Terminate edges of any deck-to-deck expansion joints with preparatory base-coat strip.

D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258. Comply with recommendations in ASTM C1193 for joint-sealant installation.

B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.5 TRAFFIC COATING INSTALLATION

A. Apply traffic coating according to ASTM C1127 and manufacturer's written instructions.

B. Apply coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.

C. Verify that wet-film thickness of each coat complies with requirements every 100 sq ft.

D. Uniformly broadcast and embed aggregate in each coat indicated to receive aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.

E. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.

F. Cure traffic coatings. Prevent contamination and damage during coating application and curing.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform Electronic Leak-Detection Testing:

1. Testing agency must test each deck area for leaks using an electronic leak-detection method that locates discontinuities in the traffic-coating membrane.

2. Testing agency must perform tests on abutting or overlapping smaller areas as necessary to cover entire test area.

3. Testing agency must create a conductive electronic field over the area of traffic coating to be tested and electronically determine locations of discontinuities or leaks, if any, in the traffic coating.

4. Testing agency must provide survey report indicating locations of discontinuities, if any.

B. Final Traffic-Coating Inspection: Arrange for traffic-coating manufacturer's technical personnel to inspect membrane installation on completion. Notify Architect or Owner 48 hours in advance of date and time of inspection.

C. Waterproofing will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports for submittal.

3.7 PROTECTION AND CLEANING

A. Protect traffic coatings 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

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes rigid and semi-rigid board insulation for use at exterior wall cavities.

B. Related Sections:

1. Section 01 81 13 – Sustainability Requirements.
2. Section 05 40 00 – Cold Formed Metal Framing: Coordination with exterior wall assemblies.
3. Section 07 21 16 – Blanket Insulation: Provision of insulation at stud cavities.
4. Section 07 27 14 – Self-Adhered Sheet Air Barriers.
5. Section 07 90 00 – Joint Protection.
6. Section 09 21 16 - Gypsum Board Assemblies: Sheathing.
7. Divisions 22 and 23 - Mechanical and Plumbing Pipe and Duct Insulation:

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
2. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
3. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction.
4. ASTM C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
5. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
6. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
7. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
8. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer information on insulation product characteristics and accessories, performance criteria, and recommended installation methods.

B. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.

a. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.

C. Closeout: Warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company with minimum five years' experience specializing in manufacturing of products specified in this Section.

B. Installer: Company with minimum three years' experience specializing in installation of Work of this Section.

C. Fire Test Response Characteristics: Provide insulation and related materials with the fire-test response characteristics specified, as determined by testing identical products per test method indicated by Underwriters Laboratories, Intertek or other testing agency acceptable to authority having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver materials to Project site in manufacturers' original packaging. Clearly identify manufacturer, contents, brand name, applicable standard, and R-value.

B. Storage and Protection: Store materials off ground, protected against weather, condensation, and damage. Comply with manufacturer's recommendations for storage and protection during installation. Replace wet or damaged insulation materials.

1.6 ENVIRONMENTAL CONDITIONS

A. Do not install adhesives when temperature or weather conditions are detrimental to successful installation.

1.7 WARRANTY

A. Division 1 – Warranties.

PART 2 – PRODUCTS

2.1 BOARD INSULATION – CAVITY WALLS

A. Manufacturers: Furnish compliant products of one of the following or approved equal:

1. Roxul

2.2 BOARD INSULATION – CURTAIN WALL CAVITY

1. Thermafiber Firespan 90 (formaldehyde free)

B. Other acceptable products (Thermafiber Rainbarrier 45).

2.3 ACCESSORIES

A. Attachment Devices: Non-corrosive mechanical fasteners in accordance with insulation manufacturer's written recommendations.

B. Adhesives: All-purpose construction adhesive in accordance with insulation manufacturer's written recommendations.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that substrate, air barrier, adjacent materials and insulation boards are dry and ready to receive insulation and adhesive, where applicable.

B. Verify that substrate surface is flat and free of materials or substances affecting adhesive bond.

3.2 INSTALLATION – CAVITY WALLS

A. Install per insulation manufacturer's written recommendations for substrate and means of cladding support.

1. Apply adhesive in beads or full-bedding and place boards to maximize contact bedding

2. Where not utilizing adhesive, friction fit boards between cladding support components and utilize impaling fasteners to substrate at recommended frequency.

3. Orient boards horizontally when possible. Butt edges and end joints to adjacent boards and protrusions and stagger end joints.

4. Place locking discs on any impaled-type fasteners.

B. Install insulation to maintain continuity of thermal protection to building elements and spaces. Cut and fit insulation tight to protrusions or interruptions to insulation plane, except keep insulation minimum three inches clear of heat emitting devices such as recessed light fixtures, chimneys and vents.

3.3 PROTECTION

A. Protect installed products and accessories from damage during construction. Replace damaged insulation boards at no additional cost to Owner.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes blanket (batt) insulation in interior partition assemblies, exterior wall assemblies, in roof/ceiling construction or where otherwise shown.

B. Related Sections:

1. Section 01 81 13 – Sustainability Requirements.
2. Section 05 40 00 – Cold Formed Metal Framing: Coordination with exterior wall assemblies.
3. Section 07 21 16 – Board Insulation: Provision of continuous insulation at exterior wall assemblies.
4. Section 07 92 00 – Joint Protection.
5. Section 09 21 16 - Gypsum Board Assemblies: Coordination with interior partition assemblies.
6. Divisions 22 and 23 - Mechanical and Plumbing Pipe and Duct Insulation:

1.2 REFERENCES

A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction.

B. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

A. Product Data: No submittal required for provision of products listed in this Section. Submit “equal” manufacturer’s literature and installation instructions for each material and accessory, clearly notating specified requirements.

B. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.
   a. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.
2. Indoor Air Quality Certificates: Furnish GreenGuard™ certification, Collaborative for High Performance Schools (CHPS) material specifications certification, or other recognized third party certification indicating equivalent mold-resistance and

emission test results. Submission not required when Product Data submission indicates provision of products listed by name in this Specification.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.

1. Fire Hazard Classification: Provide insulating materials per Flame Spread Rating and Smoke Density requirements of the California Building Code.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver materials to Project site in manufacturers' original packaging. Clearly identify manufacturer, contents, brand name, applicable standard, and R-value.

B. Storage and Protection: Store materials off ground, protected against weather, condensation, and damage. Comply with manufacturer's recommendations for storage and protection during installation.

PART 2 – PRODUCTS

2.1 BATT INSULATION

A. Unfaced Batt (“Blanket”) Insulation: ASTM C665, Type I, Class A pre-formed natural fiber or fiberglass wool conforming to the following characteristics:

1. Thermal Resistance: R-13 minimum at 3-1/2 inch thickness, R-19 minimum at 6-1/4 inch thickness.

2. Thickness: As indicated on Drawings.

3. Manufacturers: Knauf Insulation’s “Ecobatt”, CertainTeed’s “Sustainable Insulation, or equal.

B. Foil Faced Batt (“Blanket”) Insulation: ASTM C665, Type III, Class A, Category 1 pre-formed natural fiber or fiberglass wool with flanged reinforced facing, conforming to the following characteristics:

1. Thermal Resistance: R-13 minimum at 3-1/2 inch thickness, R-19 minimum at 6-1/4 inch thickness.

2. Thickness: As indicated on Drawings.

3. Manufacturers: Knauf Insulation’s “FSK-25 Foil Faced Ecobatt”, CertainTeed’s “CertaPro Commercial Sustainable Insulation”, or equal.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

C. Environmental Quality Characteristics:

1. Interior Air Quality: Furnish mold-resistant materials that are non-petroleum based, formaldehyde-free, and phenol-free.

2.3 ACCESSORIES

A. Attachment Devices: Galvanized, as specified and as recommended by insulation manufacturers; type and size to suit application.

B. Tape: Laminate of aluminum foil, glass fiber reinforcing, and kraft paper with pressure-sensitive adhesive; UL listed; recommended by insulation manufacturer.

PART 3 – EXECUTION

3.1 GENERAL

A. Manufacturer's Instructions: Prepare substrates and install the work, including components and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions.

3.2 INSTALLATION

A. General: Install insulation continuously per manufacturer's recommendations without gaps and voids in wall and ceiling assemblies indicated. Butt tightly to mechanical and electrical services within plane of insulation and at joints.

B. Provide minimum 3-1/2 inch thick product at thermal and acoustical assembly stud cavities 4 inches and shallower. Provide minimum 5-1/2 inch thick at stud cavities 6 inches and deeper.

1. Install unfaced batts where concealed within partition or wall assemblies. Friction fit snugly between framing members. Do not compress insulation.

2. Install faced batts where not concealed within partition or wall assemblies, with facing oriented to building interior. Lap ends and side flanges of membrane over framing members and retain in place per manufacturer’s recommendations. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Foamed-in-Place Insulation of the following types: Closed-cell, spray-applied, polyurethane foam insulation. (SealTite Pro One Zero)

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

- ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
  .
- ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
- ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- ASTM D2856 - Standard Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer.
- ASTM D6226 - Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
- ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- ASTM E413 - Classification for Rating Sound Insulation.
- ASTM E423 - Standard Test Method for Normal Spectral Emittance at Elevated Temperatures of Nonconducting Specimens.

- ASTM E2178 - Standard Test Method for Air Permeance of Building Materials.
- ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B.ICC Evaluation Service (ICC-ES):

- ICC-ES AC377 - Acceptance Criteria for Spray-Applied Foam Plastic Insulation.
- International Association of Plumbing and Mechanical Officials (IAPMO).
- Spray Polyurethane Foam Alliance: Professional Certification Program (SPFA PCP).

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's product data, including surface preparation and application instructions.

C. Manufacturer's Certification:
- Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- Submit manufacturer's certification from SPFA PCP as Accredited Supplier Company.
- Submit evidence that manufacturer has Dunn & Bradstreet rating of 5A or can supply performance bond.

D. Product Evaluation Reports: Submit manufacturer's product evaluation reports from accredited evaluation service.

E. Manufacturer's Project References: Submit manufacturer's list of 5 successfully completed polyurethane foam insulation projects of similar size and scope, including project name and location, name of architect, and type and quantity of materials furnished.

F. Applicator's Project References: Submit applicator's list of successfully completed polyurethane foam insulation projects, including project name and location, name of architect, and type and quantity of materials applied.

G. Warranty Documentation: Submit manufacturer's standard warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
- Manufacturer regularly engaged, for a minimum of 10 years, in the manufacturing of polyurethane foam insulation of similar type to that specified.
- Accreditation: SPFA PCP as Accredited Supplier Company.

B. Applicator's Qualifications:
- Applicator regularly engaged, for a minimum of 5 years, in application of polyurethane foam insulation of similar type to that specified.
- Certified by manufacturer to install their products.
- Use persons trained by manufacturer in polyurethane foam insulation application or certified by SPFA PCP as Master Installer - Insulation, Closed Cell.

C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity

1.5 PRE-INSTALLATION CONFERENCE

A. Convene a conference approximately two weeks before scheduled commencement of the Work.

B. Require attendance of parties directly affecting Work of this Section, including Contractor, Architect, applicator, and manufacturer's representative.

C. Review the Following:
- Materials.
- Protection of in-place conditions.
- Surface preparation.
- Application.
- Field quality control.
- Cleaning.
- Protection.
- Coordination with other Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling Requirements:
- Store materials in clean, dry area indoors.
- Store materials at 70 to 80 degrees F (21 to 27 degrees C) a minimum of 48 hours before use.
- Store materials out of direct sunlight.
- Protect materials from freezing.
- Protect materials during storage, handling, and application to prevent contamination or damage.

1.7 PROJECT CONDITIONS

A. Ambient and Substrate Temperatures: As recommended by Manufacturer.

B. Moisture: Do not apply polyurethane foam insulation when moisture in form of rain, snow, ice, fog, frost, or dew is expected during application.

C. Relative Humidity: Do not apply polyurethane foam insulation when relative humidity over 85 percent is expected during application.

D. Wind: Do not apply polyurethane foam insulation with wind speed above 12 mph (19 kmh).

E. Do not apply polyurethane foam insulation under ambient conditions outside manufacturer's limits.

1.8 WARRANTY

A.Manufacturer's Warranty: Provide manufacturer's standard limited warranty.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

2.1.1 Acceptable Manufacturer: Carlisle Spray Foam Insulation, which is located at: 100 Enterprise Dr.; Cartersville, GA 30120; Tel: 844-922-2355; web:https://www.carlislesfi.com

2.1.2 Substitutions Not permitted

2.1.3 Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 Product Requirements.

2.2 CLOSED CELL, SPRAY APPLIED, POYURETHANE FOAM INSULATION

2.2.1 Basis of Design: SealTite Pro Closed Cell Pro One Zero; as manufactured by Carlisle Spray Foam Insulation.

:

2.2.1.1 Thickness, 2 inch (50 mm)

PART 3 – EXECUTION

3.1 EXAMINATION

3.1.1 Examine areas to receive polyurethane foam insulation.

3.1.2 Notify Architect of conditions that would adversely affect application.

3.1.3 Do not begin surface preparation or application until unacceptable conditions are corrected.

3.2 PREPARATION

3.2.1 Protection of In-Place Conditions:

3.2.1.1 Protect adjacent surfaces from contact with overspray

3.2.2 Protect electrical outlet and junction boxes from contact with polyurethane foam insulation. Surface Preparation:

3.2.2.1 Prepare surfaces in accordance with manufacturer's instructions

3.2.2.2 Remove dirt, dust, debris, oil, grease, rust, loose scale, ice, frost, moisture, and other surface contaminants which could adversely affect application of polyurethane foam insulation.

3.3 INSTALLATION

3.3.1 Spray-apply polyurethane foam insulation in accordance with manufacturer's instructions at locations indicated on the Drawings.

3.3.2 Material Temperature: Maintain materials in containers at 65 to 85 degrees F (18 to 29 degrees C) while in use.

3.3.3 Ensure substrates are dry during application.

3.3.4 Insulation Thickness:

3.3.4.1 Maximum Pass Thickness: 2 inches (102 mm)

3.3.4.2 Total Thickness: Indicated on the Drawings.

3.3.5 Apply polyurethane foam insulation to uniform thickness without voids, pinholes, cracks, and crevices.

3.4 FIELD QUALITY CONTROL

3.4.1 Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

3.4.1.1 Inspect completed application of polyurethane foam insulation, including:

3.4.1.2 Total thickness.

3.4.1.3 Free of voids, pinholes, cracks, and crevices.

3.4.1.4 Adhesion to substrate.

3.5 CLEANING AND PROTECTION

3.5.1 Promptly clean surfaces that receive overspray of polyurethane foam insulation.

3.5.2 Do not use harsh cleaning materials or methods that could damage surfaces.

3.5.3 Protect Work of this Section from damage during construction.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes above-grade sheet materials for controlling vapor diffusion through slabs on-grade.

B. Related Sections:

1. Section 03 30 00 – Cast In Place Concrete.
2. Section 05 40 00 – Cold Formed Metal Framing.
3. Section 07 21 16 – Blanket Insulation.
4. Section 09 21 16 – Gypsum Board Assemblies.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction.
2. ASTM D1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
3. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.
4. ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
5. ASTM E1643 - Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
6. ASTM E1745 - Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
7. ASTM F1249 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

1.3 PERFORMANCE REQUIRMENTS

A. Underslab Sheet Vapor Retarder:

1. General: Product shall have following characteristics to provide resistance to transmission of water vapor into concrete slab and durability to resist damage due to construction-related activities.
    a. Water Vapor Permeance: ASTM E154, Section 7 or ASTM D1249; 0.010 perms (grains/(ft^2*hr*in.Hg)) maximum.
    b. Tensile Strength: ASTM E154, Section 9; 45.0 lbf/in minimum.
    c. Puncture Resistance: ASTM D1709, Method B; 2300 grams minimum.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's published product literature, including physical and performance characteristics, standard installation details, installation instructions, and general recommendations.

1.5 QUALITY ASSURANCE

A. Installer's Qualifications:

1. Minimum 3 years' experience with specified materials on projects of similar scope and complexity.

2. Acceptable to manufacturer of vapor retarder materials.

PART 2 – PRODUCTS

2.1 UNDERSLAB SHEET VAPOR RETARDER

A. Manufacturers: Furnish compliant product of one of the following or approved equal:

1. Insulation Solutions, Incorporated.

2. Raven Industries, Incorporated.

3. Stego Industries, LLC.

B. Membrane: ASTM E1745, Class A; polyethylene or polyolefin film meeting specified Performance Requirements. Basis of Specification: Stego Industries' "Stego Wrap 15 mil".

C. Accessories:

1. Seaming Tape: Manufacturer's recommended compatible pressure-sensitive adhesive tape. Minimum 4 in. wide self-adhering type designed to maintain vapor retarder integrity.

2. Mastic Adhesive: Manufacturer's recommended mastic with ASTM E96 vapor transmission rate of 0.3 perms or less.

PART 3 – EXECUTION

3.1 GENERAL

A. Underslab Vapor Retarder Manufacturer's Instructions: Prepare substrates, apply primers and install the work, including components and accessories, in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions.

1. Ensure sleeves, curbs, and projections that pass through vapor retarder are properly and rigidly installed.

2. Ensure base material is installed as specified, is free of projections and irregularities that may be detrimental to proper installation of vapor retarder.

3. Penetrations through the vapor retarder are not allowed except for reinforcing steel and permanent utilities.

3.2 UNDERSLAB VAPOR RETARDER INSTALLATION

A. Install in accordance with most stringent requirements of ASTM E1643, manufacturer's instructions, and as specified herein.

B. Place sheet to create fewest number of laps with long dimension parallel to length of the slab area. Make laps a minimum of 6" wide. Completely seal the laps and penetrations with waterproof seaming tape.

C. Further seal penetrations with liquid membrane or as recommended by manufacturer.

D. Lap vapor retarder and temporarily secure with seaming tape onto top surface of footing elements to the extent necessary to ensure they remain secured when thickened slab edges are cast. Maintain edges minimum 1-1/2 inches clear of vertical dowels.

E. Repair damaged areas by cutting patches of vapor retarder sheeting, overlapping damaged area 6 inches and taping all four sides with pressure sensitive tape. Ballast the sheet as required to hold in place and protect from damage during placement of reinforcing and concrete.

3.3 FIELD QUALITY CONTROL

A. Final Underslab Vapor Retarder Inspection: Arrange job walk with either project inspector and/or Architect immediately prior to the placement of concrete slab. Identify damaged areas and correct as indicated under Installation.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes installation of vapor emission control systems to control moisture or water vapor emission at areas of concrete slabs specified herein to received specific flooring finishes.

1. New Concrete Floor Surfaces:

a. Provision of vapor emission and alkalinity control at new concrete floors scheduled to receive carpeted and other floor finishes. The requirement for vapor emission control is absolute and not based upon testing of new concrete surfaces.

b. Testing of concrete floors after installation of vapor emission and alkalinity control if required under floor finish manufacturer's warranty requirements.

c. Provision of underlayment at treated and untreated floors as required for floor finish adhesion and/or to meet floor tolerance criteria.

B. Related Sections:

1. Section 03 30 00 – Cast in Place Concrete.

2. Section 09 68 13 – Tile Carpeting.

C. Schedule: Construction Schedule submitted by the Contractor per the General Conditions shall account for the procedures required to achieve the Work of this Section. Additional effort required to correct defects and failures shall not extend the Contract Time.

1.2 REFERENCES

A. American Concrete Institute (ACI)

1. ACI 302.2R - Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

2. ACI 117 - Specification for Tolerances for Concrete Construction and Materials

B. American Society for Testing and Materials (ASTM)

1. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.

2. ASTM C349 - Standard Test Method for Compressive Strength of Hydraulic-Cement Mortars (Using Portions of Prisms Broken in Flexure).

3. ASTM D1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes.

4. ASTM C1583 – Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
5. ASTM D7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
6. ASTM E96 - Water Vapor Transmission of Materials.
7. ASTM F710 - Preparing Concrete Floors to Receive Resilient Flooring.
8. ASTM F2170 - Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
9. ASTM F3010 – Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

C. International Concrete Repair Institute (ICRI)

1. ICRI No. 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.3 PERFORMANCE REQUIREMENTS

A. Vapor Emission Control: In-situ Relative Humidity per ASTM F2170; system must be able to perform as required with relative humidity (RH) probe reading of 100 percent.

1. Alkalinity Control: ASTM D1308; system must be insensitive to alkaline environment up to and including pH 14.
2. System must be compatible with floor finish installations, either alone or through the addition of a cementitious underlayment.
3. VOC (Mixed): 20 g/L maximum.
4. Minimum Tensile Bond Strength: ASTM D7234; 200 psi.
5. Permeance: ASTM E96 water method; maximum 0.090 perms.

B. Cementitious Underlayment: When installed with manufacturer’s recommended primer.

1. Minimum Compressive Strength: ASTM C349; 4,000 psi at 28 days.
2. Minimum Flexural Strength: ASTM C348; 800 psi at 28 days.
3. Minimum Tensile Bond Strength: ASTM D7234; 140 psi at 28 days.

1.4 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturer's complete descriptive data, installation instructions, applicable technical bulletins, and material safety data sheets.

1. Water Vapor Emission Control product.
2. Cement patching compounds, crack and joint treatment.
3. Product data for shot blasting equipment.
4. Manufacturer's qualifications and product performance history.

C. Certifications:

1. Manufacturer's written certification that all materials meet volatile organic content (VOC) limits specified herein.
2. Written approval from water vapor emissions control system manufacturer of the concrete analysis and concrete surface preparation prior to installation of coating.
   a. Include review of concrete tensile strength test results.
   b. Approval shall include that of in situ concrete relative-humidity test results before proceeding with installation.
   c. Approval shall include that of mockup tensile adhesion test results from the moisture-mitigation coating manufacturer before proceeding with installation.
3. Written approval of substrates and installation procedures from leveling underlayment manufacturer at the start of installation.

D. Testing Procedures: Manufacturer's written instructions describing the testing procedures/ methods to be used to verify the vapor emissions of the concrete slabs prior to and after the installation of the water vapor emission control system.

E. Testing Report:

1. Submit independent testing agency's vapor emissions testing report for record.
2. Submit results of wet film thickness (WTF) measurements taken during installation of vapor emission control system.

F. Manufacturer's Field Reports: Written program of execution of on-site inspection of installation.

G. Installer's Certification: Manufacturer's written certification of installer's qualifications. Include list of three (3) recently completed and similar water vapor emission control systems projects with project names, addresses, names of owners and responsible architects.

1.5 QUALITY CONTROL

A. Qualified Installer: Installer to have five (5) years' experience installing the approved water vapor emissions control system and leveling underlayment materials on projects of comparable type and size. Installer shall be either manufacturer's trained personnel or factory certified installer. Water vapor emissions control system installer shall be

experienced in surface preparation and application of the moisture mitigation system and shall be subject to inspection and control by the manufacturer.

B. Manufacturer's Qualifications: Minimum five (5) years manufacturing water vapor emissions control products. Manufacturer shall carry manufacturer's product liability insurance covering both material performance and installation workmanship for the duration of warranty program. The water vapor emissions control system shall be specifically formulated and marketed for water-vapor reduction and alkalinity control in concrete floor slabs. Water vapor emission control system design and formulation shall not have changed for a minimum of five consecutive years before the start of the work.

C. Product Performance History: Manufacturer shall provide independent laboratory test reports documenting performance of the water vapor emissions control system per the following:

1. ASTM E96 – Water Vapor Transmission (wet methods): Performance shall be documented by an independent testing laboratory indicating a maximum water vapor permeance of 0.1 perms.

2. ASTM D1308 – Insensitivity to alkaline environment up to pH 14.

3. Certify acceptance and exposure to continuous topical water contact after final cure.

D. Moisture Testing: Perform relative humidity (RH) testing of the existing concrete floor slab before the installation of moisture-mitigation system as required by the mitigation system manufacturer. Testing must be performed by an ICRI Certified Concrete Slab Moisture Testing Technician (CCSMTT). Coordinate the schedule so as to allow for proper testing before installation of moisture-mitigation system. Submit written approval of the test results from the product manufacturers before proceeding with installation.

E. Concrete Tensile Strength Testing: After mechanical preparation of the concrete surface, test the tensile strength of the concrete surface according to ASTM C1583. Perform at least three concrete tensile strength tests for every 1,000 sq ft of prepared concrete substrate. The tensile strength of the prepared substrate must be at least 200 psi. Perform additional mechanical preparation as needed to achieve required tensile strength before application of the coating.

F. Moisture Mitigation Thickness Measurements: During application of moisture-mitigation system, measure the wet film thickness (WFT) of the applied moisture-mitigation system. Take at least three WFT measurements for every 100 sq ft of mitigation coating system installed. The average WFT shall not be less than the specified thickness for each coverage rate. Adjust the coverage rate to achieve the required minimum mil thickness.

G. Representatives from the water vapor emissions control system and leveling underlayment manufacturers must be on site at the start of installation to approve substrates and installation procedures in writing. In addition, representative of the self-leveling

underlayment to confirm and approve proper mixing quantities and procedures in writing.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver packaged materials to the project site in manufacturer's original, unopened containers with seals unbroken and labels indicating brand names, colors, patterns, and quality designations legible and intact.

B. Storage and Protection: Do not open containers or remove labels until materials have been inspected and accepted.

1.7 ENVIRONMENTAL CONDITIONS

A. Install system treatments when concrete surface temperatures exceed 60ºF and rain is not expected.

1.8 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Product warranties and product bonds. Warranties shall pay for all costs associated with repairs and replacement upon notification of defects.

B. Material Warranty: Provide material manufacturer's product warranty against defects in manufacturing and workmanship for a minimum of ten (10) years from date of Substantial Completion.

1. Warrant against failure of flooring system due to concrete water vapor emissions to the system installed. Warranty shall not exclude concrete cracking.

2. Warranty to include replacement of finish flooring material, adhesive, water vapor control systems, and labor costs for removal and replacement of those products, provided failure is due to vapor emissions within the limits of installed system.

3. By terms of warranty, agree to remove and replace other Work, as required which has been connected to or superimposed on the substrate material to be replaced.

C. Installation Warranty: Provide a Contactor's warranty stating that all work is installed according to these Specifications and manufacturers' directions and that defective work will be repaired or replaced to the Owner's satisfaction at no additional cost to the Owner. State that the obligation of the Warranties shall run directly to the Owner and may be enforced by the Owner against the Contractor, shall survive the termination of the Contract, and shall not be limited by conditions other than this Contract. The Contractor's warranty shall be for a term of two years from the Date of Substantial Completion. Providing this warranty is a requirement to receive final payment.

PART 2 – PRODUCTS

2.1 CONCRETE VAPOR EMISSION CONTROL SYSTEM

A. Manufacturers: Furnish compliant products of a single manufacturer selected from one of the following or approved equal.

1. Koster American Corporation.
2. Mapei Corporation.
3. United States Gypsum Durock Brand (NST System).

B. Product Description: One or two-component, VOC-compliant, low viscosity, 100% solids epoxy vapor barrier meeting specified system performance requirements. Koster American Corporation's "Koster VAP I 2000" is the Basis of the Specification.

2.2 MATERIALS

A. Vapor Control Coating:

1. ASTM F3010 – Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.
2. ASTM E96 – Water Vapor Transmission (wet methods): Performance shall be documented by an independent testing laboratory indicating a maximum water vapor permeance of 0.1 perms.
3. ASTM D1308 – Insensitivity to alkaline environment up to pH 14.
4. Certified acceptance and exposure to continuous topical water contact after final cure.

B. Underlayment Primer: Vapor Control Coating manufacturer's recommended non-porous substrate primer suitable for use over vapor control coating or un-coated concrete. Basis of Specification: "Koster VAP I 06 Primer".

C. Underlayment: High-strength, non-shrinking, self-leveling polymer modified portland cement-based concrete meeting or exceeding specified performance criteria. Feather edge conditions shall not exceed 1/8-inch thickness. Gypsum-based underlayment and filler materials not permitted. Basis of Specification: "Koster SL".

D. Miscellaneous: Vapor Control Coating manufacturer's recommended products for sealing of movement joints; repair of non-movement joints, cracks and spalls.

2.3 EQUIPMENT

A. Shot-Blasting Equipment: The device must be equipped with a local exhaust-capture system such that the bulk of the shot, dust, and debris is captured by the system and contained for disposal.

B. Only electrically or pneumatic powered equipment may be used indoors. No combustion engines or gas powered equipment allowed.

PART 3 – EXECUTION

3.1 SURFACE PREPARATION

A. Inspect with manufacturer's representative all concrete floor surfaces scheduled to receive resilient, carpet or terrazzo floor finish with regard to their suitability to receive moisture vapor reduction system.

B. Vacuum shot-blast all areas of the structural slab to receive moisture-mitigation system. Grinding of the concrete is allowed only in areas inaccessible with the shot-blasting equipment or for edging purposes. Acid etching is not permitted.

1. Provide dust control during shot-blasting and grinding procedures using vacuums and other dry means. Wet cutting and grinding is not permitted.

C. Provide a surface profile matching International Concrete Repair Institute (ICRI) Concrete Surface Profiles (CSP) of 3. Surface profiles shall be sufficient for bonding of the moisture-mitigation system and shall not result in bruising of the concrete substrate.

D. If the concrete substrate is too uneven to provide a uniform film thickness of the moisture-mitigation coating, pre-smooth the substrate using manufacturer-approved moisture resistant patch.

E. At the completion of surface preparation, perform concrete tensile strength tests.

3.2 CONCRETE VAPOR EMISSION CONTROL APPLICATION

A. Receive written approval of the prepared substrate from the moisture-mitigation system manufacturer before proceeding with installation.

1. If any measured RH levels exceed 98%, notify the Architect and moisture-mitigation system manufacturer for approval prior to proceeding with installation.

B. Re-vacuum slab surface to remove dust or debris accumulation before moisture mitigation installation.

C. Repair all cracks, expansion joints, control joints, and open surface honeycombs and fill in accordance with Manufacturer's recommendations. Reinforcing fibers that are visible after shot blasting must be removed and vacuumed leaving no fibers left on the concrete surface.

1. All expansion and moving joints must extend through the moisture-mitigation coating and finish flooring.

2. Clean all cracks and voids wider than 1/32 in. and fill with joint filler as required by the manufacturer.

D. Mix vapor emission control system components in clean containers and install per manufacturer's instructions.

E. Spread vapor emission control using a squeegee and back-roll with a 3/8 inch nap epoxy-rated roller to provide complete coverage of treatment area. Coverage rates are dependent upon surface profile and porosity as well as the level of moisture. 100 – 150

square feet per gallon is typical: Refer to manufacturer's technical data sheets for specific wet film thickness (WFT).

F. Maintain the required thickness of the moisture-mitigation system over high areas in the prepared concrete substrate. During application of moisture-mitigation system, measure the wet film thickness (WFT) of the applied moisture-mitigation system. Take at least three WFT measurements for every 100 sq ft of mitigation coating system installed. The average WFT shall not be less than the specified thickness for each coverage rate. Adjust the coverage rate to achieve the required minimum mil thickness.

G. Apply uniform coating of moisture-mitigation system across entire substrate surface. Extend coating to continuously contact wall bases and penetrations so that there are not voids or discontinuities at the intersections of the coating with any penetrations or terminations.

H. At transitions between work phases, moisture-mitigation system must be continuous without any gaps or areas of nonexistent coverage. Clean and prepare installed moisture-mitigation coating as required by the manufacturer to provide proper integration with next phase of moisture mitigation system installation.

I. Allow the moisture-mitigation system to cure as required by the moisture-mitigation system manufacturer before installation of the leveling underlayment and not less than 12 hours. Protect applied moisture-mitigation coating from damage and construction traffic before installation of the leveling underlayment.

J. Inspect the moisture-mitigation system installation after curing. If pinholes are present, prepare the surface and provide an additional layer of the moisture-mitigation system as required by the moisture mitigation system manufacturer.

3.3 UNDERLAYMENT APPLICATION

A. Clean all dust, dirt, and debris from the surface of the cured moisture-mitigation system before application of the leveling underlayment and primer. Do not sand or grind the cured moisture-mitigation system.

B. Mix and apply leveling underlayment primer as specified by the primer manufacturer over the moisture-mitigation system. Use a short-nap roller, leaving a thin coat of primer over the entire surface. Do not leave any bare spots. Brush off puddles and excess primer. Apply primer within 1 hr of mixing. Allow primer to dry to a thin, slightly tacky, film (3 – 24 hrs).

C. Mix and install leveling underlayment as specified by the manufacturer onto primed moisture-mitigation system. Minimum required underlayment thickness to match the depth of existing concrete removal and be coordinated with manufacturer's requirements for intended adhesive for new floor finishes and the thickness of the various floor finishes.

1. Pour the liquid leveling underlayment and spread into place. Wear nonmetallic cleats to avoid leaving marks in the liquid leveling underlayment.

2. If an underlayment application of greater than 1/4 inches is required, prepare the surface as required by the moisture-mitigation system manufacturer.

D. Allow the leveling underlayment to cure as required by the leveling underlayment manufacturer before installation of floor finishes or temporary protection, 16 hours minimum. Protect the leveling underlayment from traffic during the entire cure period and until finish flooring is installed.

3.4 FIELD QUALITY CONTROL

A. Provide testing of all treated slabs by Independent Testing Agency when required by floor finish manufacturer to verify performance of vapor emission control system for purposes of flooring manufacturer's warranty. Provide testing in accordance with the protocol identified by the floor finish manufacturer.

B. Re-apply control system in areas where concrete testing exceeds vapor emissions tolerances. Re-test area per same Standard at no additional cost to Owner.

3.5 CLEANING AND PROTECTION

A. Clean all tools and equipment with solvent recommended by manufacturer immediately after use.

B. Remove all debris resulting from preparation and installation of moisture-mitigation system and underlayment from project site daily.

C. Protect the surface of the leveling underlayment from abuse by other trades by the use of Masonite or other suitable protection course

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes fluid-applied air and weather barrier systems and accessories to control the movement of moisture and air through a wall.

B. Work Specified Elsewhere:

1. Section 07 62 00 – Sheet Metal Flashing and Trim.
2. Section 07 92 00 – Joint Sealants.
3. Section 09 21 16 – Gypsum Board Assemblies: Exterior Sheathing.

1.2 REFERENCES

A. Air Barrier Association of America (ABAA):

1. ABAA Quality Assurance Program.

B. American Society for Testing and Materials (ASTM):

1. ASTM C1193 – Guide for Use of Joint Sealants.
2. ASTM E96 – Test Methods for Water Vapor Transmission of Materials, Procedure B.
3. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials.

1.3 PERFORMANCE REQUIREMENTS

1. Service Temperature: Minimum 175 degrees Fahrenheit.
2. Membrane Air Permeance: ASTM E2178; test pressure of 1.57 lb/ft^2 (75 Pa); maximum 0.002 cfm/ ft^2 (0.002 L/s/m^2).
3. Membrane Water Vapor Permeance: ASTM E96, Method B; minimum 10.0 perms.
4. Manufacturer’s Warranted Maximum UV Exposure Limit: 60 days or greater.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data, tested physical and performance properties, installation instructions, and instructions for evaluating, preparing and treating substrate.

1. Include VOC content of each material, and applicable legal limit in the project jurisdiction.

B. Quality Assurance/Quality Control Submittals:

1. Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents and product data have been reviewed with qualified manufacturer representatives. The statement shall certify that proposed materials are permanently chemically compatible with each of the adjacent material proposed for use.

2. Installer's Qualifications.

C. Closeout Submittals:

1. Warranties.

1.5 QUALITY ASSURANCE

A. Manufacturer: Obtain primary materials from a single manufacturer that is a currently accredited member of the ABAA. Secondary materials shall be obtained from a source acceptable to the primary materials manufacturer.

B. Qualified Installer: Installer to be currently accredited by the AABA and have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer. Installation of weather barriers, membrane flashings, and sealant shall be the responsibility of the membrane applicator to ensure undivided responsibility.

C. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include Owner Representatives, Architect, Contractor, and subcontractors whose work is relevant to this Specification Section.

D. Field Quality Assurance: Implement the ABAA Quality Assurance Program requirements. Cooperate with AABA and other inspectors, as well as Owner's testing and inspection agencies. Do not conceal Work until it has been inspected, tested and accepted.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Products delivered to the job site shall be in the original unopened containers or wrappings.

B. Storage and Protection: Handle all materials to prevent damage. Place all materials on pallets and fully protected from moisture with canvas tarpaulins.

1.7 PROJECT / SITE CONDITIONS

A. Proceed with weather barrier installation only after substrate preparation is complete. Obtain acceptance from the weather barriers manufacturer's representative of substrate surface before proceeding with installation. Weather barriers contractor is

responsible to ensure substrate is adequately prepared to receive weather barriers system.

1.8 WARRANTY

A. General: Warranties shall pay for all costs associated with repairs and replacement upon notification of defects.

B. Material Warranty: Provide material manufacturer's product warranty for a minimum of five (5) years from date of Substantial Completion.

C. Installation Warranty: Provide installation warranty for a minimum of five (5) years from date of Substantial Completion. Warranty shall include all accessories and materials of the air barrier assembly against failures including loss of air-tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

PART 2 – PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIERS

A. Manufacturers: Furnish compliant products of one of the following or approved equal:

1. Grace Construction Products.
2. Henry Company.
3. Sto Corporation.

B. System Description: Fluid-applied, single component, acrylic membrane that cures to form a resilient, monolithic, fully-bonded elastomeric sheet when applied to construction substrates. Material shall allow the passage of water vapor, while forming a barrier against air and liquid water. Basis of specification: Grace Construction Products' "Perm-A-Barrier VP" and associated accessories.

2.2 COMPONENTS

A. Fluid-Applied Vapor Permeable Membrane Air Barrier: UV-resistant, elastomeric, modified bituminous membrane. "Perm-A-Barrier VP". (FAM).

B. Flashing Membrane: Self-adhering, UV-resistant, polyethylene film reinforced rubberized asphalt laminated to layer of butyl adhesive with release liner backing. "Perm-A-Barrier Detail Membrane". (SAFM).

C. Detail Membrane: Self-adhering, UV-resistant, polyethylene film reinforced rubberized asphalt bonded to aluminum film, approximately 40 mil thick. "Perm-A-Barrier Aluminum Flashing" at openings. (SADM).

D. Primer: Air and weather barrier manufacturer's water-based wall primer for self-adhering transition membrane. "Perm-A-Barrier WB Primer".

E. Sealants, Mastics Adhesives and Tapes: As recommended by Manufacturer.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that substrates and conditions, including any cladding anchors, are ready to accept the Work of this section. Notify Architect in writing of any discrepancies.

B. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the membranes. Fill voids, gaps and spalled areas in substrate to provide an even plane.

3.2 SURFACE PREPARATION

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods that are acceptable to manufacturer of the fluid-applied air barrier assembly.

B. Exterior sheathing panels: Ensure that the boards are sufficiently stabilized with corners and edges fastened with appropriate screws. Pre-treat all screw heads and board joints per air barrier manufacturer's recommendations.

C. Install primer to substrate if instructed by air barrier manufacturer.

D. Related Materials: Treat construction joints and install flashing as shown on Drawings and recommended by manufacturer.

E. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

F. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

3.3 INSTALLATION

A. Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material manufacturer's instructions and the following (unless manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):

1. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended by the material manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.

2. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches, unless greater overlap is recommended by the material manufacturer.

3. Seal around all penetrations with termination mastic/sealant, detail flashing or other procedure in accordance with material manufacturer's instructions, ensuring chemical compatibility amongst adjoining materials.

4. Connect air 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, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material manufacturer's instructions.

5. Provide transition material at changes in substrate plane with detail membrane under membrane to eliminate all inside and outside corners and to make a smooth transition from one plane to another.

6. Provide mechanically fastened non-corrosive metal sheet or other manufacturer approved transition material to span gaps greater than 1 inch in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch overlap on both edges.

7. Lap transition membrane over top edge of through-wall, head- or other metal flashings. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch overlap on both edges.

8. Provide backup for the membrane to accommodate anticipated movement or use other manufacturer approved transition material at deflection and control joints.

9. Provide transition to the joint assemblies at expansion and seismic joints.

10. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the material manufacturer.

11. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.

12. Inspect installation assembly prior to AABA inspection and repair punctures, damaged areas and inadequately lapped seams with a patch of detail membrane extending 6 inches beyond repaired areas.

3.4 FIELD QUALITY CONTROL

A. Inspections: Air-barrier materials, accessories and installation are subject to AABA's testing agency for inspection for compliance with requirements. Notify AABA 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. Arrange and pay for site audits by ABAA to verify conformance with the material manufacturer's instructions, the site Quality Assurance Program used by ABAA, and this section of the project specification.

B. Perform audits at rate recommended by AABA.

C. Forward written audit reports to the Architect within 10 working days of the inspection and test being performed.

D. Air barriers will be considered defective if they do not pass tests and inspections. Remove and replace deficient air barrier components and retest as specified above.

3.5 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Protect air and weather barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace main air barrier material when exposure exceeds manufacturer’s limit.

C. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

D. Remove masking materials after installation.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes single-ply thermoplastic-polyolefin (TPO) roofing membrane with flashings and other components required to comprise a complete, fully-functioning roofing system as shown and specified.

B. Related Sections:

1. Section 03 38 00 – Post Tensioned Structural Concrete
2. Section 05 40 00 – Cold Formed Metal Framing: Metal Backing for securement of membrane and flashing at parapet walls.
3. Section 06 10 53 – Miscellaneous Rough Carpentry: Nailers and blocking at openings.
4. Section 07 14 16 – Cold-Fluid Applied Waterproofing: Coordination at equipment pads.
5. Section 07 62 00 – Flashing and Sheet Metal.
6. Section 09 21 16 – Gypsum Board Assemblies: Sheathing.
7. Divisions 22 and 23: Pipes, Drains, Vents, Ducts, and their Flashings.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
2. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
3. ASTM D6878 – Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing.

B. Cool Roof Rating Council (CCRC)

1. CCRC-1 – Standard Practice for Measuring Solar Reflectance of a Flat, Opaque, and Heterogeneous Surface Using a Portable Solar Reflectometer.

C. Factory Mutual Global (FM):

1. FM DS 1-28 - Wind Loads to Roof Systems and Roof Deck Securement.
2. FM – Approval Guide.

D. National Roofing Contractors Association (NRCA):

1. NRCA - The NRCA Roofing Manual: Membrane Roof Systems.

E. Single Ply Roofing Institute (SPRI):

a. Wind Load Design Guide For Low Sloped Flexible Membrane Roofing Systems

b. Fastener Selection Guide

c. ANSI/SPRI FX-1 Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.

d. ANSI/SPRI ES-1 Wind Design Guide For Edge Systems Used With Low Slope Roofing Systems

1.3 PERFORMANCE REQUIREMENTS

A. General: Installed roofing membrane system shall remain watertight and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacturer, fabrication, installation, or other defects in construction.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent waterproofing membranes and sealants under conditions of service and application required, as demonstrated by membrane roofing and accessory item manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system identical to systems that have been successfully testing by a qualified testing and inspection agency to resist uplift pressure calculated according to ASCE / SEI 7.

D. Listings: UL 1897, 90 psf uplift pressure resistance; Factory Mutual I-90.

E. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70, emissivity not less than 0.75 and Solar Reflectance Index (SRI) not less than 78 when tested according to CRRC-1.

1.4 SUBMITTALS

A. Product Data: Product literature, installation instructions, and general recommendations from manufacturers of single ply membrane system for types of roofing required.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying roofing system complies with specified Performance Requirements and verification that roofing system is appropriate for proposed project conditions. Provide certification that materials are compatible with sealants, flashings and other accessories materials at transition conditions.

C. Qualification Data: Roofing manufacturer’s written certification or license of installer.

D. Warranties: Provide sample special warranties for review prior to installation.

E. Provide documentation of roofing material w/ 3-year aged SRI of 64, or initial SR of 82.

1.5 QUALITY ASSURANCE

A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.

C. Labels and Approvals: Provide labeled materials that have been tested and listed by Underwriter's Laboratories (UL) in "Building Materials Directory" or by other nationally-recognized testing laboratory for application indicated with Class A rated materials system for roof slopes indicated.

D. Source: Manufacturer shall produce its own membrane. No private label membranes will be accepted.

E. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, Contractor, and subcontractors whose work is relevant to this Specification Section. Provide at least 72 hours advance notice to participants prior to convening pre-installation meeting.

1. Manufacturer's Representative: Present as required for compliance with manufacturer's warranty requirements during installation and shall review and approve completion of roof installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver materials in original unopened containers or packages bearing manufacturer's labels intact and with seals unbroken.

B. Storage and Protection: Store materials in a dry location in manner to prevent damage and intrusion of foreign matter.

1.7 WARRANTY

A. Installers: Provide five (5) year contractor guarantee starting from the date of final acceptance of all roofs. The bonding company must also cover the first year warranty. Provisions of the warranty must cover defects in workmanship and materials; and all corrective actions necessary to repair damage to the roof membrane and insulation materials caused by roof leaks or improper application.

1. Warranty: Must cover damage to building and contents resulting from failure to resist penetration of water during construction.

B. Manufacturer: Provide twenty (20) year manufacturer standard warranty for manufacturer's membrane and accessory products covering defects in workmanship and materials; and all corrective actions necessary to repair damage to the roof membrane and separation board materials caused by roof leaks or improper application. Warranty must include coverage of ponding water areas.

1.8 PROJECT / SITE CONDITIONS

A. Weather Conditions: Do not apply materials during adverse weather or when ambient temperature is below 50 degrees F, unless otherwise approved by roofing manufacturer.

PART 2 – PRODUCTS

2.1 THERMOPLASTIC-POLYOLEFIN ROOFING

A. Manufacturers: Provide compliant products of one of the following or approved equal.

1. Carlisle SynTec Systems.
2. Firestone Corporation.
3. Johns Manville.

B. System Description: Single-ply, fleece-back, thermoplastic-polyolefin (TPO) membrane fully-adhered to sloped lightweight insulating concrete substrate. Basis of Specification: Firestone Corporation’s “UltraPly TPO XR Roofing System”. Components and Accessories listed below are those of Firestone Corporation unless otherwise indicated.

2.2 COMPONENTS

A. Membrane: ASTM D6878; 60 mils thick heat weldable, polyester reinforced with fleece backing. Surface color: Manufacturer’s standard white.

B. Walkway Pads: Membrane manufacturer’s heat-weldable, textured TPO membrane walkway pad. Color: Light Gray or other low-contrast color with roofing membrane and as acceptable to Architect. “UltraPly TPO Walkway Pad” or equal.

C. Cover Board: ASTM C1177; fiberglass mat-faced, water-resistant gypsum core, formulated for roofing application. Georgia Pacific Gypsum LLC’s DensDeck Prime® with Eonic Technology.

1. Fire Resistance Classifications: UL 790 and UL 1256.
2. Thickness: 1/2 inch thick or as indicated, 5/8 inch thick where substituted for sheathing at back of parapets.

D. Rigid Insulation: ASTM C1289, Type-II, Class 1, faced rigid cellular polyisocyanurate roof insulation, CBC-compliant for foam plastic insulation. Straight and tapered

versions required to achieve thickness and slopes shown on Drawings. Firestone Corporation's "ISO 95+ GL" or approved equal.

1. Compressive Strength: 20 psi minimum.

2. Long Term Thermal Resistance (LTTR) Value: 6.0 per inch thickness minimum.

2.3 ACCESSORIES

A. General: Meet VOC requirements of the Bay Area Air Quality Management District (BAAQMD).

B. Flashing Membrane: Heat weldable, reinforced 60-mil thick TPO resin sheet.

C. Bonding Adhesive: ISO Spray R or manufacturers approved adhesive.

D. Splice Cleaner: "Splice Wash, SW-100".

E. Seam and Lap Sealant: Manufacturer's liquid TPO sealing compound with a consistency equal to that of honey at room temperature.

F. Edge Sealant: Manufacturer's polymer-based sealant. VOC: 250 g/L or less. Color to match membrane. "UltraPly TPO Cut Edge Sealant LVOC".

G. General Purpose Sealant: Single component, non-sag sealant compatible with roof membrane. Color: White. VOC: 250 g/L or less.

H. Pre-molded / prefabricated detail components: Provide inside/outside corners and PVC pipe boots in sizes to fit diameters from 3/4-inch to 11 inches. Color: Match membrane.

I. Clad Sheet Metal Flashing: TPO-clad galvanized metal flashing as recommended by membrane manufacturer and as shown in Drawings. Color: Match membrane. "UltraPly TPO Coated Metal".

J. Clad Gravel Stops: TPO-clad metal flashing as recommended by membrane manufacturer and as shown in Drawings. Color: Match membrane.

K. Joint Cover Strips: For use in waterproofing joints of metal.

L. Seam Plates and Fasteners: Manufacturer's recommended corrosion-resistant fasteners and plates.

M. Metal Termination Bars: Manufacturer's standard "U" shaped, nominal 1-inch wide, flat, roll-formed aluminum or stainless steel bar.

N. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion resistant provisions, designed for fastening membrane to substrate and acceptable to membrane roofing system manufacturer: "Sarandisc XPS Plates with XP Fasteners".

O. Metal Batten: Manufacturer's standard, aluminum-zinc-alloy coated or zinc-coated steel sheets, 1-inch wide by 0.05-inch thick.

P. Metal Hose Clamp: Stainless steel worm drive type by Murray Corporation's “Gold Seal”, or equal.

Q. Separator Tape: Aluminum tape for covering asphalt contaminated deck components or penetrations.

R. Metal Backing: Furnished under Section 05 40 00.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with following requirements and other conditions affecting performance of roofing system.

1. Verify roof openings and penetrations are in place and curbs are set and braced and roof drain bodies are securely clamped in place.

2. Verify blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and nailers match thicknesses of insulation.

3. Verify metal backing is properly located as required for securement of membrane, termination bars and flashings to framed vertical surfaces of walls and parapets.

4. Verify minimum concrete drying period recommended by roofing system manufacturer has passed.

5. Verify lightweight insulating concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.

6. Verify concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed. Concrete shall be free of projections and depressions.

B. Notify Owner of any discrepancies between Drawings and actual field conditions, and of any elements requiring repair at time of installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with manufacturer's instructions for preparation of substrate to receive sheet membrane. Verify that penetrations, expansion joints, and blocking are in place and secured and that roof drains are properly clamped into position.

B. Clean substrate of dust, debris, oil, grease, and other substances detrimental to sheet membrane. Remove sharp projections.

C. Install flashings and accessory items as indicated and recommended.

D. Prime substrate where recommended by manufacturer of materials being installed.

E. Prevent compounds from entering and clogging drains and conductors, and from spilling or migrating onto surfaces of other work.

F. Notify Owner of any discrepancies between Drawings and actual field conditions, and of any elements that require repair at time of installation.

3.3 INSTALLATION

A. General: Comply with Manufacturer's instructions and NRCA Roofing Manual, except where more stringent requirements are indicated or specified.

1. Possible Inclement Weather during Installation

a. Temporary Waterstops: Install temporary waterstops at the end of each day's work. The new membrane shall be sealed to substrate so that water will not travel under the roofing. Seal the edge by placing in a continuous, heavy application of grid adhesive of 6 inch width. During inclement weather, contractor shall provide labor necessary to monitor waterstops. Remove temporary waterstops at the start of the next day's work by removing the contaminated edges of membrane and properly dispose. If any water enters under the roofing assembly, the contractor shall remove and replace the area at no additional expense to the Owner.

b. Concurrent Flashing Installation: Install flashings concurrently with the membrane in order to maintain a watertight condition as the work progresses. Schedule each day's work to coincide with the temporary waterstop locations.

2. Do not install the roofing membrane in direct contact with any product containing asphalt, coal tar pitch, creosote or penta-based materials. Do not allow waste products containing petroleum, grease, acid, solvents, vegetable or mineral oils, animal fats et cetera, or steam venting to come into direct contact with the roofing membrane.

3. Do not weld or otherwise use open flame near roofing material without appropriate safety precautions.

B. Rigid Insulation Installation:

1. Set layers of rigid insulation in cold adhesive in built up sections over deck substrate to achieve thicknesses and slopes indicated.

C. Cover Board Installation:

1. Install substrate boards over insulation with long joints in continuous straight lines, perpendicular to roof slopes, with end joints staggered between joints. Tightly butt substrate boards together and set in cold adhesive.

D. Membrane Installation: Start installation only in presence of manufacturer's technical representative when required for warranty.

1. Utilize manufacturer's recommended "Fold Method". Unroll the sheet roofing and position without stretching the membrane. Allow the membrane to relax at least 15 minutes when the temperature is above 60 degrees F., or 30 minutes when temperatures are cooler.

2. Prior to installation, inspect for damage. Remove sections of membrane that are creased or damaged.

3. Lap sheets as recommended by manufacturer depending upon installation method used, minimum 3-inches wide when automatic machine-welding and 4-inches wide when hand-welding. Shingle ("waterfall") side laps with slope of roof where possible. Turn sheets minimum of 4 inches up perimeter vertical surfaces, at obstructions in the field, and as shown.

4. Once the membrane has been properly positioned, fold the sheet back and apply bonding adhesive to substrate in accordance with manufacturer's instructions. Do not apply adhesive to the lap areas of the sheet that will be welded. Mechanically fasten to perimeter vertical surfaces & other obstructions using manufacturer's recommended seam plates and fasteners. The adhered membrane shall be smooth and free of wrinkles and buckles.

5. Seam Overlaps:

    a. Clean and dry in accordance with Manufacturer's instructions. No sealants shall be present within lap areas.

    b. Welding equipment shall be provided by or approved by membrane manufacturer. Mechanics intending to use equipment shall have successfully completed training course provided by manufacturer's representative prior to welding.

    c. At laps without selvage edge, weld membrane cover strips over laps.

    d. Hand Welding: Hand-welded seams shall be completed in three stages. Hot-air welding equipment shall be allowed to warm up for at least one minute prior to welding.

        i. Lap shall be tack welded every 36-inches to hold seam in place.

        ii. Back edge of seam shall be welded with narrow but continuous weld to prevent loss of hot air during final welding.

        iii. Nozzle shall be inserted into seam at a 45-degree angle to edge of membrane. Once proper welding temperature has been reached and membrane begins to "flow", hand roller shall be positioned perpendicular to nozzle and rolled lightly.

    e. Machine Welding: Machine welded seams shall be achieved by use of automatic welding equipment.

        i. Follow manufacturer's instructions and local codes for electric supply, grounding, and over current protection observed.

        ii. Verify automatic welding machines requirements. Verify need for dedicated circuit power or dedicated portable generator.

f. T-Joints (Three-Way Laps):

i. When welding three-way overlap with membrane thicker than 60-mil, top edge of second membrane layer shall be shaved down to create smooth transition for top membrane layer to conform to for positive welding. Chamfer edge of membrane using means and methods acceptable to manufacturer.

6. Membrane Flashing: Flash penetrations, walls and drains with cured flashing membrane, as recommended by manufacturer. Use prefabricated accessories when feasible, in lieu of uncured flashing. Terminate flashings per manufacturer's standard details.

a. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

b. Shingle joints on sloped substrate in direction of drainage.

c. Fully Adhered Application: Apply adhesive to substrate per Manufacturer's recommendations. Fully embed membrane in adhesive except in areas directly over or within three inches of expansion joints.

d. Overlap edges and ends. Do not apply adhesive in lap areas that will be hot-air welded.

e. At vertical walls, extend flashing 4 inches minimum onto horizontal field membrane and underneath rigid flashings at top of wall and as shown. Lap with wall air barriers for continuous weather-resistant envelope, ensuring lapped materials are compatible. Provide horizontal termination bars per manufacturer's recommendations and as shown.

f. At flashing intersections with vertical surfaces:

i. Extend membrane up a minimum of four inches and as indicated onto vertical surfaces.

ii. Fully adhere flexible flashing over membrane and up to nail strips.

iii. Secure flashing with termination bar.

g. Around roof penetrations, use prefabricated flashing collars and seal flanges and flashing with flexible flashing.

h. Coordinate installation of roof drains and sumps and related flashings.

7. Sealants: Install in accordance with instructions of roofing system manufacturer and as specified in Section 07 90 00.

E. Walkway Pads: Adhere walkway pads in accordance with manufacturer's instructions. Where walkway intersects valleys in roof slope, install with 6-inch gap in walkway pad along valley to facilitate drainage.

3.4 SHEET METAL FLASHING INSTALLATION

A. General: Refer to 07 62 00 for installation of coated and un-coated metal flashings. Coordinate installation where metal flashing interfaces with roofing membrane to

prevent metal from pulling free or buckling, and provide seal to prevent moisture from entering roofing system or Building.

B. Complete metal work in conjunction with waterproofing and flashings so that watertight condition exists daily.

C. Provide metal to achieve adequate resistance to bending and allow for normal thermal expansion and contraction.

D. Ensure metal joints are watertight. At prefabricated reglets and counter flashings, lap flashings a minimum of 4-inches and bed in sealant. At bent flashings, provide sealed butt joint with 8-inch backer plate.

E. Metal flashing shall have minimum 4-inches nailing flange and shall be fastened into solid wood blocking with fixings of same type with two rows of annular ring nails, 4-inches on center staggered, or into concrete anchors 6-inches on center staggered. Fixings shall penetrate wood nailer minimum of 1-1/4 inch.

F. Adjacent sheets of TPO coated metal shall be spaced 1/4-inch apart. End joints of metal shall be fastened 6-inches on center. Joints shall be covered with 1-inch wide aluminum tape. 4-inch wide membrane flashing strip shall be hot-air welded over joint (lap dimensions etc.).

3.5 FIELD QUALITY CONTROL

A. Continuous Inspection: Refer Quality Control article for field continuous inspection.

B. Welded Seam Quality Control:

1. Completed welded seams shall be checked by installer after cooling for continuity using rounded screwdriver or other suitable blunt object.

2. Visible evidence that welding is proceeding correctly is smoke during welding operation, shiny membrane surfaces, and an uninterrupted flow of black material from edge of completed joints.

3. On-site evaluation of welded seams shall be made daily by Contractor at locations as directed by membrane manufacturer’s representative.

4. 2-inch wide cross-section samples of welded seams shall be taken at least three times daily through completed seams. Correct welds display failure from shearing of membrane prior to separation of weld. Each test cut shall be patched by Contractor at no extra cost to Owner.

C. Final Roof Inspection: Upon completion of installation, representative of roof membrane manufacture shall inspect to verify that membrane system has been installed in accordance with manufacturer’s approved specifications and details.

D. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional inspections, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

A. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.7 PROTECTION

A. Protect membrane roofing system from damage and wear during remainder of construction period. At end of construction period, or at time when remaining construction will not affect or endanger roofing, make a final inspection of roofing and prepare a written report to Owner, describing nature and extent of deterioration or damage found.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes flashings, counterflashings, copings and other fabricated sheet metal items.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking for roofing substrate profiles.
3. Section 07 13 00 – Sheet Waterproofing: Coordination of systems.
4. Section 07 27 26 – Fluid-Applied Membrane Air Barriers
5. Section 07 42 13 – Perforated Metal Wall Panels.
6. Section 07 42 43 – Aluminum Composite Wall Panels.
7. Section 07 54 23 –Thermoplastic Polyolefin Roofing.
8. Section 07 90 00 - Joint Protection.
9. Section 08 12 14 – Standard Steel Frames.
10. Section 08 41 13 – Aluminum-Framed Storefronts and Entrances.
11. Section 08 44 13 – Glazed Aluminum Curtain Walls.
12. Section 09 90 00 - Painting and Coating: Field painting.
13. Divisions 23 and 26: Roof curbs for equipment.

1.2 REFERENCES

A. American Architectural Manufacturers Association:

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
2. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

B. ASTM International:

1. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A625 - Standard Specification for Tin Mill Products, Black Plate, Single Reduced.

3. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM A755 - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
5. ASTM B32 - Standard Specification for Solder Metal.
6. ASTM B101 - Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction.
7. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
8. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
9. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
10. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
11. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
12. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

C. Copper Development Association Inc.:

1. CDA - Copper in Architecture - Handbook.

D. Federal Specification Unit:

1. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.

E. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - Architectural Sheet Metal Manual.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

C. Samples:

1. Submit two samples 12 x 12 inch in size illustrating shop applied metal finish color.

D. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.

2. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.

1.4 QUALITY ASSURANCE

A. Thermal Movement: Fabricate and install sheet metal flashings to allow for movement of components without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects when subject to 100 year seasonal temperature ranges.

1.5 QUALIFICATIONS

A. Installer: Company specializing in sheet metal work with minimum three years' experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Product storage and handling requirements.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials causing discoloration or staining.

1.7 COORDINATION

A. Coordinate with Work of other Sections requiring flashing and trim components for a complete assembly.

PART 2 – PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM

A. Galvanized Steel: ASTM A653; structural steel sheet, G90 zinc coating; 0.024 inch thick steel.

B. Pre-Finished Galvanized Steel Sheet: ASTM A755; structural steel sheet, G90 zinc coating; 0.024 inch thick core steel, shop pre-coated with fluoropolymer finish as specified in Factory Finishing; color as selected.

C. Pre-Finished Aluminum Sheet: ASTM B209; 3003 alloy, H14 temper; 0.032 inch thick; finish shop pre-coated with fluoropolymer finish as specified in Factory Finishing; color as selected.

D. Lead: ASTM B749, 0.039 inch thick.

E. Stainless Steel: ASTM A240; Type 316, dead soft fully annealed, 0.015 inch thick; smooth surface, smooth surface, Number 4 finish.

F. Copper: ASTM B370; H00 temper except where 060 temper is required for forming, 16 oz. (0.022 inch thick).

2.2 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal. Match finish of exposed heads with material being fastened.

B. Slip Sheet: 5-lb. rosin sized building paper.

C. Primer: Zinc molybdate type for Aluminum, Stainless Steel and Galvanized Steel. Galvanized iron type primer may be used with Galvanized Steel.

D. Protective Backing Paint: Zinc molybdate alkyd or FS TT-C-494, Bituminous.

E. Mastic Sealant: Type E butyl, non-hardening, non-skinning, non-drying, non-migrating sealant. Ultra-violet and ozone resistant.

F. Elastomeric Sealant: Type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 90 00.

G. Plastic Cement: ASTM D4586, Type I.

H. Reglets: Non-corrosive metal units of type and profile indicated, compatible with flashing indicated. Acceptable manufacturers: Fry Reglet Corporation, W.P. Hickman Company, MM System Corporation.

I. Solder: ASTM B32.

1. For use with Steel: 50-50 tin/lead, with rosin flux.

2. For use with Stainless Steel: 60-40 tin/lead, with acid-chloride type flux, except use rosin flux over tinned surfaces.

2.3 FABRICATION

A. Shop-fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of Reference Standards and other recognized industry practices. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated. Apply bituminous paint on concealed surfaces of metal flashings, except where metal flashing will be in contact with incompatible materials (including PVC).

B. Fabricate cleats of same material as sheet metal, interlocking with sheet.

C. Unless indicated otherwise on Drawings, form pieces in longest possible equal lengths up to 10 feet. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Non-Moving Joints: Form only non-moving material with sealed flat lock seams or mechanically fasten and solder 1 inch minimum lap or as indicated on Drawings. Neutralize flux after soldering.

E. Expansion Provisions: Use sealed lapped or bayonet-type seams. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently water/weatherproof, form expansion joints of interlocking hooked seams, not less than 1 inch deep, filled with mastic sealant concealed within joints.

F. Fabricate corners from one piece with minimum 18 inch long legs; seam or solder for rigidity, seal with sealant.

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.4 FACTORY FINISHING

A. Fluoropolymer Coating: Provide where indicated or specified for sheet metal system, thermally cured, conforming to AAMA 2605.

B. Washcoat: Finish concealed side of metal sheets with washcoat compatible with finish system, as recommended by finish system manufacturer.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division - Administrative Requirements: Coordination and project conditions.

B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

C. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets to lines and levels indicated on Drawings. Seal top of reglets with sealant.

C. Paint concealed metal surfaces with protective backing paint to minimum dry film thickness of 15 mil.

D. Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install slip sheet and polyethylene underlayment.

1. Weatherlap joints as recommended by system manufacturer, not less than 2 in. at building paper.

2. Secure underlayment in place, stagger joints between layers; lap ends minimum 6 inches; stagger end joints.

3. Apply layer of sheet membrane underlayment extending 18 inches from penetrations, including windows and doors; start at bottom of penetration and weatherlap joints; apply top layer over metal flashing to direct water to exterior.

3.3 INSTALLATION

A. Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with Reference Standards. Complete all metal work in conjunction with waterproofing so that a watertight condition exists daily.

B. Insert counterflashings into reglets either by snap-in seal arrangement or by welding in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Flashings shall have a 4-inch minimum nailing flange or as shown and shall be fastened into solid wood blocking or metal backing with fasteners of the same type with two rows of annular ring nails 4 inches on center staggered. Fasteners shall penetrate wood blocking a minimum of 1-1/4 inch. Anchor flanges to concrete with acceptable concrete anchors 6 inches on center staggered. Bed flanges of Work in thick coat of bituminous roofing cement where required for waterproof performance.

F. Lap expansion joints minimum of 2 inches and seal watertight with plastic cement.

G. Seal metal joints watertight.

H. Provide soldered metal joints with full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

3.4 FIELD QUALITY CONTROL

A. Exposed Metal Surfaces: Clean and remove substances that might cause corrosion of metal or deterioration of finishes.

B. Protection: Protect flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

C. Touch up scratched and damaged metal to match new. Remove and replace sheet metal units that cannot be repaired to look identical to adjacent sheet metal when viewed from 15 feet away.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes provision of pedestrian plaza paver systems at elevated terraces.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 03 30 00 – Cast-in-Place Concrete: Structural and topping slabs supporting paver system.
3. Section 07 13 00 – Sheet Waterproofing: Waterproofing and protection course beneath paver system.
4. Section 07 62 00 – Sheet Metal Flashing and Trim: Coordination of pavers with perimeter flashing tie-in to waterproofing.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
2. ASTM C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading).
3. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

1.3 SUBMITTALS

A. Comply with Division 1 – Submittal Procedures.

B. Product Data. Submit manufacturer’s data for paver units and support components.

C. Samples:

1. Submit 12 x 12 inch minimum paver section for verification of color and texture. **Apply sealer to one-half of top surface of each sample.**
2. Pedestal support system components.

D. Warranties: Warranties specified in this Section.

1.4 QUALITY CONTROL

A. Comply with Division 1 – Quality Control.

B. Single Responsibility: Obtain each plaza paver component type through one source from a single manufacturer.

C. Mockup: Construct one 6-foot by 6-foot area of each type of paving, size and pattern, indicating pavers requiring cutting. Install pavers on pedestals.

1. Include specified edge treatments per Drawings.

2. Mockup may be installed and remain as part of the permanent installation if found acceptable by the Owner's representative.

3. The approved mockup shall become the project standard for tolerances and appearance.

1.5 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. Discharge materials carefully and store on clean concrete surface or raised platform in safe, dry area at temperatures above 40 and below 75 degrees F. Protect materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Waterproofing Inspection: Do not install plaza paver system until waterproofing field quality control inspections and repairs have been completed per Section 07 13 00.

1.7 WARRANTY

A. Manufacturer Warranty: Pavers and pedestal components against failure within specified performance criteria for period of 10 years from Substantial Completion.

PART 2 – PRODUCTS

2.1 PLAZA PAVER SYSTEMS

A. System Description: Concrete unit pavers supported on an elevated adjustable pedestal system installed over waterproofing membrane protection course (specified elsewhere). Pavers to be installed level.

B. Pavers: High density concrete units, 2 inches thick, as manufactured by the Concrete Collaborative or compliant, approved equal.

1. Weight: 24-28 psf.

2. Compressive Strength: ASTM C140; 8,000 psi minimum.

3 Flexural Strength: ASTM C293; 725 psi minimum.

4. Size: 16" x 32"

5. Color: Trails Series "Taupe", meeting specified minimum SRI value.

6. Finish: “Flekk” and “Midgrind”, distributed in accordance with Drawings.

7. **Sealer: Paver manufacturer’s recommended, silane-based water and oil repelling clear liquid.**

C. Pedestals: Elevated polypropylene system capable of providing adjustable-height support between 1 inch and 24 inches in height. Top plate with 1/8” thick vertical tabs for proper positioning of pavers when shimmed. Staybars and wire crosstie system available for bracing of taller installations.

1. Bearing Capacity: 1,250 lbs minimum per pedestal.

2. Minimum Bearing Area: 38 square inches (equivalent to 7-inch diameter).

3. Product: Bison Innovative Products’ “Versadjust” or compliant, approved equal.

D. Leveling Shims: EPDM or other resilient shims configured to coordinate with pedestals. Pedestal manufacturer’s standard thicknesses to 1/8-inch thick maximum. Color: Black.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Section 01 81 13 Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Heat Island Effect: Paver product shall provide minimum Solar Reflectance Index (SRI) value of 29 when calculated in accordance with ASTM E1980.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Inspect and ensure that area drains, waterproofing membrane, protection course, metal flashings, and all other components to be concealed by plaza paver system are complete and watertight.

3.2 PREPARATION

A. Clean and prepare substrates.

B. Lay-out pavers as required to best suit installation. Establish grid pattern for pedestals, avoiding layouts that require cutting paver units smaller than one-half their dimension. Lay out pedestals so that paver rows at opposite sides of the field are of equal size (symmetric) in each direction, and as indicated on Drawings if specifically identified.

3.3 INSTALLATION

A. Install pavers on pedestals to provide a level paver surface. Furnish staybar and bracing system in accordance with pedestal manufacturer's recommendations.

B. Do not exceed 1/8-inch variation in elevation of adjacent pavers. Level pavers as necessary, using shims to achieve required elevations.

C. Ensure paver surfaces at entrances comply with Drawings, and in no case more than 1/4 inch lower than interior finish floor.

D. Cut pavers as necessary along valleys and ridges of slopes and cut neatly around fixed obstructions.

E. Apply two applications of sealer to exposed surface of pavers according to sealant manufacturer's directions. Do not apply sealer until paver installation is complete, all debris is removed from the area and pavers have been cleaned in accordance with CLEANING article in this Section.

1. Do not apply sealer in windy conditions. Protect surface of pavers from introduction of foreign matter while sealer is curing.

3.4 CLEANING

A. During the course of the work and upon completion, remove any cut dust from the surface of the pavers by means of high-pressure water or air to avoid discoloration of pavers.

3.5 PROTECTION

A. Protect pavers from damage and wear during remainder of construction period.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes firestopping systems consisting of a material, or combination of materials installed to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and/or hot gases through penetrations, blank openings, construction joints, or at perimeter fire containment in or adjacent to fire-rated barriers.

1. Penetrations through fire-resistance-rated floor and roof assemblies requiring protected openings including both empty openings and openings that contain penetrations.

2. Penetrations through fire-resistance-rated wall assemblies including both empty openings and openings that contain penetrations.

3. Membrane penetrations in fire-resistance-rated wall assemblies where items penetrate one side of barrier only.

4. Joints in fire-resistance-rated assemblies to allow independent movement.

5. Joints through penetrations and membrane penetrations in Smoke Barriers and Smoke Partitions.

B. Related Sections:

1. Section 07 90 00 – Joint Protection

2. Section 09 21 16 - Gypsum Board Assemblies at through-penetrations or joints.

3. Divisions 21 and 22: Fire Suppression and Plumbing work requiring through-penetration firestopping.

4. Division 23: HVAC work requiring through-penetration firestopping.

5. Division 26: Electrical work requiring through-penetration firestopping.

6. Divisions 27 and 28: Communications, Security and Fire Alarm work requiring through-penetration firestopping.

1.2 REFERENCES

A. Comply with applicable requirements of following standards. Where these standards conflict with other specified requirements, most restrictive requirement shall govern.

B. American Society for Testing and Materials International (ASTM):

1. E84 - Test Method for Surface Burning Characteristics of Building Materials.

2. E119 - Test Method for Fire Tests of Building Construction and Materials.

3. E136 - Test Method for Behavior of Materials in a Vertical Tube Furnace at 750F.

4. E814 - Fire Tests of Through-Penetration Fire Stops.
5. E1399 - Cyclic Movement and Measuring Minimum and Maximum Joint Widths.
6. E1966 - Test Method for Resistance of Building Joint.
7. E2174 - Standard Practice for On-Site Inspection of Installed Fire Stops.
8. E2307 -- Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus

C. California Office of the State Fire Marshal Listing Service.

D. Factory Mutual (FM) Research:

1. FM Approval Standard of Firestop Contractors – Class 4991.

E. Firestop Contractors International Association (FCIA):

1. MOP: Manual of Practice.

F. International Firestop Council (IFC):

1. Ref. 1 Recommended IFC Guidelines for Evaluating Firestop Engineering Judgments (April 2001).
2. Ref. 2 Inspectors Field Pocket Guide.

G. National Fire Protection Association (NFPA):

1. NFPA 70 - National Electric Code.
2. NFPA 221 - Fire Walls and Fire Barriers (preliminary to be released).
3. NFPA 251 - Fire Tests of Building Construction and Materials.

H. Underwriters Laboratories, Inc. (UL):

1. UL 263 Fire Tests of Building Construction and Materials.
2. UL 723 Surface Burning Characteristics of Building Materials.
3. UL 1479 Fire-Tests of Through-Penetration Fire Stops.
4. UL 2079 Tests for Fire Resistance of Building Joint Systems.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Through Penetrations: Provide firestopping systems that are produced to resist the spread of fire, and passage of smoke and other gases according to requirements indicated, including but not limited to following:

1. Firestop all penetrations through fire resistance rated wall and floor assemblies and other locations as indicated on Drawings.

2. Provide and install complete through penetration firestopping systems that have been tested and approved by third party testing agency.

3. F - Rated Through-Penetration Firestopping Systems: Provide through-penetration firestopping systems with F ratings indicated, as determined per ASTM E 814, but not less than one hour or fire-resistance rating of construction being penetrated.

4. T - Rated Through-Penetration Firestopping Systems: Provide firestopping systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where indicated by Code.

B. Fire-Resistive Joints: Provide joint systems with fire-resistance ratings indicated, as determined per UL 2079 or (ASTM E 1399 and E 1966), but not less than fire-resistance rating of construction in which joint occurs.

C. Where firestopping is exposed to view, traffic, moisture, and physical damage, provide appropriate firestopping systems for these conditions.

D. Where there is no specific third party tested and classified firestop system available for a particular firestopping configuration, firestopping contractor shall obtain from firestopping manufacturer an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFFRA). Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFFRA) shall be prepared to comply with CBC Part 1 by licensed engineer.

1.4 SUBMITTALS

A. Submit Manufacturers Product Data Sheets for each type of product selected. Certify that firestopping material shall be asbestos free and complies with local regulations.

1. Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC’s) and are nontoxic to building occupants.

B. Submit system design listings, including illustrations from a qualified testing and inspection agency that is applicable to each firestopping configuration.

1. Where there is no specific third party tested and classified firestopping system available for particular firestopping configuration, firestopping contractor shall obtain from firestopping manufacturer an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA).

C. Submit subcontractor qualifications as noted in “Quality Assurance” article.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide firestopping System Design Listing by a testing and inspection agency in accordance with appropriate ASTM Standard(s) per article 1.3. A qualified testing and inspection agency may be Underwriters Laboratory Inc. (UL), factory Mutual Research (FM), Intertek Testing Services, Omega Point

Laboratories (OPL) or other agencies performing testing and follow-up inspection services for firestopping materials.

B. Subcontractor Qualifications: Acceptable installer firms shall be:

1. FM Approved in accordance with FM Standard 4991 – Approval of Firestop Contractors.

2. Licensed by the State or OSHPD, where applicable.

3. Shown to have successfully completed not less than 5 comparable scale projects.

4. Firestopping Contractors International Association Contractor Member in good standing.

C. Single Source Responsibility: Obtain firestopping systems from a single manufacturer for each kind of through penetration and construction joint condition indicated.

1. Materials of different manufacture shall not be intermixed in same firestopping system or opening.

2. Tested and listed firestopping systems are to be used before an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) is installed.

1.6 REGULATORY REQUIREMENTS

A. Firestopping systems, other than those shown on Drawings, will be subjected to agency having jurisdiction review.

B. Do not use firestopping systems that have no agency having jurisdiction approval for this Project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer.

B. Store and handle firestopping materials in accordance with manufacturers written instructions.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Install firestopping in accordance with manufacturers written instructions.

B. Ventilation: Ventilate per firestopping manufacturers' instructions or Material Safety Data Sheet (MSDS)

1.9 SEQUENCING AND SCHEDULING

A. Project coordination is essential to inform and communicate to parties involved with firestopping installation of their role, and manner they can impact firestopping installation, on Project. Pre-construction meeting shall be scheduled and required for all parties involved prior to start of construction.

B. Do not cover up firestopping installations until Owner's inspection agency or Inspector of Record (IOR) has examined each installation.

1.10 ENVIRONMENTAL REGULATIONS

A. Materials shall be asbestos free and comply with local VOC Regulations.

B. If required, hazardous disposal of firestopping materials shall be strictly observed as noted on individual MSDS.

PART 2 – PRODUCTS

2.1 THROUGH PENETRATION AND JOINT FIRESTOPPING SYSTEMS

A. Systems listed by approved testing agencies, as identified in PART 1 above, may be used, providing they conform to construction type, penetrant type, annular space requirements and fire rating involved in each separate instance.

B. Manufacturer of firestop products shall have been successfully producing and supplying these products for a period of not less than five years, and be able to show evidence of at least ten projects where similar products have been installed and accepted.

C. Manufacturers: Furnish products of manufacturers listed below for use in tested assemblies referenced on Drawings or approved by Architect.

1. 3M Fire Protection Products
2. AD Fire Protection Systems
3. Hilti, Incorporated
4. Specified Technologies Incorporated’s (STI)

2.2 THROUGH PENETRATION AND JOINT FIRESTOPPING MATERIAL

A. Firestopping Sealant: ASTM E1966, UL-classified, gunnable single-component acrylic or silicone sealant compound listed for use in tested assemblies. Furnish in manufacturer’s standard red color at all non-visible locations. At locations exposed to view, furnish paintable firestopping sealant or alternate standard color selected by Architect.

1. Head of wall and other fire-resistive movement joints: Silicone firestopping capable of 45% minimum joint movement.

B. Firestopping Joint Spray: ASTM E1966 and E2307, UL-classified, sprayable single-component flexible acrylic sealant compound listed for use in tested assemblies. Furnish in manufacturer's standard red color at all non-visible locations. At locations exposed to view, furnish paintable firestopping sealant or alternate standard color selected by Architect. Basis of Specification: Specified Technologies' "AS200".

C. Mineral Wool Firesafing (Insulation): Minimum 4 pcf un-faced. Basis of Specification: Thermafiber's "Thermafiber Safing".

D. Outlet Box Pads: ASTM E814, moldable putty pad type, listed for fire rating up to 2 hours.

PART 3 – EXECUTION

3.1 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 firestopping. Notify responsible party or parties of any unsatisfactory conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond. Do not allow spillage and migration onto exposed surfaces.

B. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work. Remove tape as soon as it is possible to do so without disturbing firestopping seal with substrates.

C. Verify that system components are clean, dry, and ready for installation.

D. Verify that field dimensions are as shown on Drawings and as recommended by manufacturer.

3.3 INSTALLING THROUGH PENETRATION FIRESTOPS

A. General: Comply with "System Performance Requirements" article in Part 1 and through-penetration firestopping manufacturer's published installation instructions and drawings pertaining to products and applications indicated.

1. Coordinate with other trades to assure that all pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed prior to installation of firestopping assemblies.

2. Schedule work to assure that partitions and all other construction that conceals penetrations are not erected prior to installation of firestopping and smoke seals.

B. Install forming/damming materials and other accessories in accordance with manufacturers written instructions.

C. Install fill materials for through-penetration firestopping systems by proven techniques to produce following results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

2. Install materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces.

3.4 INSTALLING FIRESTOP JOINT SYSTEMS

A. General: Comply with "System Performance Requirements" article in PART 1 and with join firestopping manufacturer's installation instructions and drawings pertaining to products and applications indicated.

1. Install joint fillers to provide support of firestopping materials during application and at position required to produce cross-sectional shapes and depths of installed firestopping material relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.

B. Install systems by proven techniques that result in firestopping materials:

1. Directly contacting and fully wetting joint substrates.

2. Completely filling recesses provided for each joint configuration,

3. Providing uniform, cross-sectional shapes and depths relative to joint width that optimize movement capability.

C. Tool non-sag firestopping materials immediately after their application and prior to time skinning or begins. Form smooth, uniform beads of configuration indicated or required to:

1. Produce fire-resistance rating

2. To eliminate air pockets

3. To ensure contact and adhesion with sides of joint.

3.5 FIELD QUALITY CONTROL

A. Inspection – Owner’s inspection agency or IOR will examine through penetration and joint firestopping in accordance with ASTM E2174. Inspection agency or IOR will examine firestopping and will determine, in general, that firestopping has been installed in compliance with requirements of tested and listed firestopping system, and installation process conforms to FM 4991.

B. Inspector shall advise Contractor of any deficiencies noted within one (1) working day.

C. Do not conceal firestopping systems with other construction until inspection agency or IOR has verified that firestopping installation complies with requirements.

D. Where deficiencies are found, repair or replace firestopping so that it complies with requirements of tested and listed system design.

3.6 CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses. Use methods and cleaning materials approved by manufacturers of firestopping products and or assemblies in which openings and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances. If damage caused by others, owner and general contractor to instruct firestopping contractor to make appropriate repairs and charge to appropriate trades.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes sealants, caulks and accessories, at interior and exterior, as required for complete installation as shown and specified.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 04 21 13 – Brick Veneer Masonry.
3. Section 07 21 16 – Blanket Insulation: Batts used at acoustical assemblies.
4. Section 07 27 26 – Fluid-Applied Membrane Air Barriers.
5. Section 07 42 43 – Aluminum Composite Wall Panels.
6. Section 07 62 00 – Sheet Metal Flashing and Trim.
7. Section 08 12 14 – Standard Steel Frames.
8. Section 08 41 13 – Aluminum-Framed Storefronts and Entrances.
9. Section 08 44 13 – Glazed Aluminum Curtain Walls.
10. Section 08 80 00 –Glazing.
11. Section 09 21 16 – Gypsum Board Assemblies.
12. Section 09 31 13 – Thin-Set Ceramic Tiling.
13. Section 09 90 00 – Painting and Coatings.
14. Section 10 28 00 – Sanitary Accessories.
15. Divisions 22 and 23: Sealants at mechanical and plumbing work.
16. Division 26 and 27: Sealants at electrical and telecommunications work.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM)

1. ASTM C834: Standard Specification for Latex Sealants.
2. ASTM C919: Standard Practice for Use of Sealants in Acoustical Applications.
3. ASTM C920: Standard Specification for Elastomeric Joint Sealants.
4. ASTM C1193: Standard Guide for Use of Joint Sealants.
5. ASTM C1247: Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids.

6. ASTM C1248: Test Method for Staining of Porous Substrate by Joint Sealants.
7. ASTM C1330: Specification for Cylindrical Sealant backing for Use with Cold Liquid-Applied Sealants.
8. ASTM E90: Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

B. South Coast Air Quality Management District (SCAQMD)

1. SCAQMD Rule 1168: Adhesive and Sealant Applications.

C. National Association of Architectural Metal Manufacturers (NAAMM):

1. NAAMM Standard SG-1: Specification for Dense Rubber-Like Compression Gasket Material.

1.3 SYSTEM DESCRIPTION

A. Exterior Joint Sealants: Provide materials produced and installed to establish and maintain watertight, airtight, continuous, and flexible seals without staining or adversely affecting joint substrates or adjacent materials.

B. Interior Joint Sealants: Provide materials produced and installed to establish and maintain airtight, continuous, water-resistant seals without staining or adversely affecting joint substrates or adjacent materials.

C. Environmental Requirements: For joint sealants applied on site within the waterproofing membrane, provide only joint sealants that conform to VOC requirements in South Coast Air Quality Management District Rule 1168.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s literature and Material Safety Data Sheets for each material and accessory, clearly notating specified requirements.

1. Product Test Reports and Compatibility and Adhesion Test Reports: Submit for each sealant type for applicable substrates, indicating evidence of compliance with requirements and recommendations for primers and substrate preparation.

B. Samples:

1. Samples for Initial Selection: Provide manufacturer’s color charts consisting of strips of cured sealants showing full range of colors available for each product exposed to view from minimum of three manufacturer’s for each type for selection by Owner.
2. Design Reference Samples: For each type of and color of sealant required, provide samples of sealants in 1/2 inch joints formed between two 12-inches long strips of material matching appearance of exposed surfaces adjacent to joint sealants.

a. Label samples to indicate product and location in Work. Samples will be reviewed for appearance only. Compliance with other requirements is responsibility of Contractor.

C. Quality Control Submittals: Submit certificates for Owner's information.

1. Sealant manufacturer's written statement of products and compatibility.

2. Installer's Qualifications.

D. Closeout Submittals: Submit for Owner's documentation:

1. Warranties.

E. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Indoor Air Quality Certificates: Certify volatile organic compound content for each interior sealant and related primer. See 01 81 13 Sustainable Design Requirements.

1.5 QUALITY CONTROL

A. Single Source Responsibility: Obtain joint sealant materials from single manufacturer for each different product type required.

B. Compatibility: Before purchase of each required material, confirm its compatibility with each other material it will be applied to in joint system as well as itself during and after curing.

1. Certificates: Sealant manufacturer's written statement that sealant applications and materials, including surface preparation, primers, and back-up materials provide proper adhesion are compatible with substrate materials and finishes in contact therewith, and conform to specified design criteria.

C. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5-years documented experience.

D. Qualified Installer: Installer to have 5-years experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

E. Pre-Installation Meetings: Before start of Work, meet at Site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to Work. Meeting shall include Owner, Architect, Architect's consultants, Contractor, and subcontractors whose work is relevant to this Section.

F. Pre-Construction Field Adhesion Testing: Prior to installation of elastomeric and rigid joint sealants, field test their adhesion to joint substrates as follows:

1. Locate test joints where accepted by Owner.

2. Conduct field test for each kind of sealant and joint substrate.

3. Arrange for tests to occur with sealant manufacturer's representative present.

4. Test joint sealants by hand-pull method as follows:

   a. Install sealant in 60-inches long joints using same material and methods for joint preparation and joint sealant installation required for complete work. Allow sealants to cure fully before testing.

   b. Make knife cuts from one side of joint to other side, follow by two cuts approximately 2-inches long at sides of joint and meeting cross cut at one end. Place a mark 1-inch from cross cut end of 2-inch piece.

   c. Use finger to grasp 2-inch piece of sealant between cross cut end and 1-inch mark, pull firmly at 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension. Hold this position for 10-seconds.

   d. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, then repeat procedure for opposite side.

   e. Report whether sealant fail to adhere to joint substrates or tear cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealant that fails test, re-test until satisfactory adhesion is achieved.

   f. Sealants not indicating adhesive failure from testing, in absence of other indications of non-compliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with Division 1 – Product Requirements.

B. Packing, Shipping, Handling, and Unloading: Deliver materials in original, tightly sealed containers or unopened packages with manufacturer's name, labels, and product identification intact.

C. Storage and Protection: Store materials out of weather in original containers or unopened packages as recommended by manufacturer.

1.7 PROJECT / SITE CONDITIONS

A. Weather Conditions: Do not apply materials under extreme temperature conditions when joint openings are at maximum or minimum width and during wet weather when surfaces are not dry.

1.8 SCHEDULING

A. General: Coordinate Work with the work of Sections affected by sealants to assure Work is performed in proper sequence and in manner to cause no delay.

1.9 WARRANTY

A. General: Warrant each system free from defects in material for 20 years and workmanship for 2 years such as failure of watertightness, adhesion, cohesion, resistance to weather, migration, flow, staining, and other forms of deterioration. Repair or replace defective Work appearing within warranty periods at Contractor's expense.

1. Building Sealant Systems: 20 years.

2. Traffic Sealant Systems: 5 years.

3. Include removal and replacement of super-imposed work of other trades, repair or replace defective Work appearing within warranty periods at Contractor's expense.

B. Warranty/guarantee shall further state that sealants are warranted/guaranteed against:

1. Adhesive or cohesive failure of sealants in joints where movement is within manufacturer’s published range of maximum extension and compression capability for base sealant.

2. Crazing greater than 3-mils in depth developing on surface of sealant material.

3. Staining of surface adjacent to sealant joints, by sealants, primers, and joint filler materials, by migrating through building materials in contact with them.

4. Puncture, abrasion, or tear failure due to pedestrian or vehicular traffic in self-leveling polyurethane base sealant installed at pedestrian or vehicular traffic surfaces.

PART 2 – PRODUCTS

2.1 JOINT SEALANT MATERIALS

A. Compatibility: Provide joint sealant materials and miscellaneous materials that are compatible with one another and with joint substrates under conditions of service and application as demonstrated by sealant manufacturers based on testing and field experience.

B. Colors:

1. Concealed Material: Any of manufacturer's standard colors. Use same color throughout project.

2. Exposed Material: Manufacturer's standard color(s), matching Design Reference Samples as selected by Owner.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Indoor Environmental Quality Characteristics:

1. Adhesives and Sealants; Sealant Primers: Maximum volatile organic compound content in accordance with Section 01 81 13.

2.3 ELASTOMERIC JOINT SEALANTS

A. Stain-Test-Response Characteristics: Provide products undergone testing in accordance to ASTM C1248 and have not stained porous joint substrates indicated for Project.

B. Suitability for Immersion in Liquids: Provide products undergone testing in accordance to ASTM C1247 and qualify for length of exposure indicated by reference to ASTM C920 for Class 1 or 2, for joints that will be continuously immersed in liquids. Liquid used for testing is deionized water, unless otherwise indicated.

C. Building Sealant: Elastomeric for general exterior building use and other sealant applications where a specific type is not otherwise identified.

1. General: ASTM C920, Type S, Grade NS, Use NT, single-component silicone sealant, for joints with moderate to maximum movement.

a. Movement Capacity: Provide building sealants that have capacity to move not less than 50-percent in both compression and 100-percent extension.

2. Manufacturers and Types: General Electric's “Silpruf 2000”, Dow's “790”, Dow's “791”, Dow's “795”, Tremco “Spectrum 1”, or accepted equal.

D. High Temperature Sealant: Elastomeric for exposure to temperatures consistently in excess of 200-degrees F with capability to perform under intermittent exposures up to 500-degrees F.

1. One part silicone sealant, non-paintable.

2. Manufacturers and Types: Polymeric Systems Inc’s “PSI-613 High Temperature Silicone Adhesive/Sealant”, Dow's “Hi-Temp Silicone Sealant”, or accepted equal.

E. Traffic Sealant: Urethane for exterior and interior horizontal joints subject to traffic.

1. General: ASTM C920, Type M, Grade P, Use T, multi-component polyurethane, pourable and immersible type.

2. Manufacturers and Types: Pacific Polymers, Inc. “Elasto-Thane 227 R Type II, Tremco’s “Vulkem 245”, Pecora's “NR-200 Urexpan”, Sonneborn's “Sonolastic Paving Joint Sealant”, or accepted equal.

F. Sanitary Sealant: Provide for joints between plumbing fixtures, toilet accessories and other equipment, and, interior joints between plumbing fixtures and adjoining walls, floors, and counters, including non-porous surfaces.

1. General: ASTM C920, Type S, Grade NS, Class 25, and Uses NT, G, and A, standard white color, one-part mildew-resistant silicone sealant.

a. Shore A Hardness of 35 (plus 5) at ultimate cure with 25-percent movement capacity.

2. Manufacturers and Types: GE's “SCS 1702”, Dow's “786”, Tremco’s “Tremsil 200”, or accepted equal.

2.4 LATEX JOINT SEALANTS

A. Acoustical Sealant: ASTM E90 tested to demonstrate reduction in airborne sound transmission through exposed and concealed joints in building construction. ASTM C834 acrylic latex sealant shall be non-skinning, non-hardening, flexible sealant specifically designed for sealing gypsum wallboard. Sealant shall be capable of spanning 1/2-inch wide by 3/8-inch deep gaps.

1. Pecora Corporation’s “AC-20 FTR Acoustical and Insulation Sealant”.

2. United States Gypsum Corporation’s “Sheetrock Acoustical Sealant”.

B. General Purpose Latex Caulk: ASTM C834, Type P, Grade NF, non-sag, paintable, non-staining type. Provide for general sealing of static joints in woodwork, casework, and similar assemblies primarily for appearance.

1. Bostik Findley’s “Chem-Calk 600”.

2. Pecora Corporation’s “AC-20+”.

3. Schnee-Morehead, Incorporated’s “SM 8200”.

4. Sonneborn’s “Sonolac”.

5. Tremco’s “Tremflex 834”.

2.5 ACCESSORIES

A. Joint Primer/Sealer: Provide type of joint primer/-sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

B. Joint Sealant Backing (Backer Rod): Provide open cell at interior conditions, and closed cell exterior conditions, polyurethane backer rods, non-staining, compatible with joint substrates, sealants, primers, and other joint fillers, do not outgas, and are approved for application by sealant manufacturer.

1. General: ASTM C1330, Type O for interior conditions and Type C for exterior conditions.

2. Manufacturers and Types: Backer Rod Manufacturing, Inc.’s “Denver Foam”, ITP’s “TundraFoam”, Nomaco’s “Foam Pak II”, or accepted equal.

C. Bond Breaker Tape: 4- to 6-mil thick polyethylene tape with pressure-sensitive adhesive on one side, as recommended by sealant manufacturer.

D. Cleaning Solvent: Non-corrosive type recommended by manufacturer; compatible with joint substrates.

E. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 – EXECUTION

3.1 GENERAL

A. Manufacturer's Instructions: Prepare substrates, apply primers and install the work, including components and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive Work and remedy detrimental conditions.

3.2 EXAMINATION

A. Inspect joints and spaces to receive sealant, and verify that:

1. Surfaces are free from bituminous materials, release agents, bond breakers, curing compounds, water repellants, or other deleterious surface treatments.

2. Metallic surfaces are free from rust, mill-scale, coatings, oil, and grease.

3. Aluminum surfaces are free of protective materials.

4. Concrete and plaster surfaces have been cured.

5. Joints and spaces requiring sealing are at correct or normal width.

3.3 PREPARATION

A. Perform preparation in accordance with ASTM C1193.

B. Cleaning: Clean joint substrates immediately before installation of sealant.

1. Sealant Bond: Remove dirt, insecure coatings, moisture, and other substances which would interfere with bond of sealant.

2. Cleaning Solvent: Use to clean joint surfaces. Wipe joints free of solvent, using clean, dry white cotton cloths or white, lint-less paper.

C. Tests: Do not install sealant until pre-construction tests for durability and adhesion in peel on applicable type substrates have been successfully completed.

D. Priming and Sealing: Prime or seal joint surfaces in accordance to sealant manufacturers’ printed instructions. Do not allow primer/sealer to spill or migrate to adjoining surfaces.

1. Make preliminary tests to insure primers will not stain exposed materials or deteriorate back-up material.

3.4 INSTALLATION

A. Perform installation in accordance with ASTM C1193.

B. Backer Rod: Install for building sealant and other elastomeric sealants, except where recommended to be omitted by sealant manufacturer for application shown, or backed by other solid substrate.

C. Techniques: Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete wetting of joint bond surfaces equally on opposite sides.

1. Sealant Rabbet: Except as otherwise indicated, fill, and tool as required, to a slightly concave surface, slightly below adjoining surfaces.

2. Intersections: Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

D. Sealant Depths: Install sealants to depths as recommended by sealant manufacturer, but within following general limitations:

1. Floor and Similar Joints Subject to Traffic: And other abrasion and indentation exposures, fill joints to a depth equal to 75-percent of joint width, but not more than 3/4-inch deep nor less than 3/8-inch deep.

2. Joints Not Subject to Traffic: Fill joints to depth equal to 50-percent of joint width, but not more than 1/2-inch deep nor less than 1/4-inch deep.

E. Compressible Seals: Install as shown and per manufacturer's recommendations. Use specified building sealant to adhere and seal butt joints, bed both sides of extrusion in continuous bead, and seal both sides of extrusion face in conjunction with bond breaker tape.

3.5 CLEANING AND CURING

A. Cleaning: Clean adjoining surfaces to eliminate evidence of spillage; do not mar surfaces.

B. Curing: Cure joint sealants per manufacturer's instructions and recommendations to obtain high early-bond strength, internal cohesive strength, and surface durability.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: Hollow metal steel frames for doors and interior glazed lites (windows).

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 07 62 00 – Sheet Metal Flashing and Trim.
3. Section 08 14 16 - Flush Wood Doors: Provision of doors.
4. Section 08 71 00 - Door Hardware: Provision of hardware, silencers, and gasketing.
5. Section 08 80 00 – Glazing: Provision of glass and glazing.
6. Section 09 21 10 – Gypsum Board Assemblies: Framing for door openings.
7. Section 09 24 00 – Cement Plastering.
8. Section 09 90 00 – Painting and Coating: Finish painting.

1.2 REFERENCES:

A. American National Standards Institute (ANSI):

1. ANSI A250.8/SDI 100 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
3. ANSI A250.11 - Recommended Erection Instructions for Steel Frames.

B. American Society for Testing and Materials International (ASTM):

1. ASTM A 366 - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
2. ASTM A 568 - Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
3. ASTM A 569 - Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality.
4. ASTM A 620 - Standard Specification for Drawing Steel (DS), Sheet, Carbon, Cold-Rolled’
5. ASTM E152 - Methods of Fire Tests of Door Assemblies.

C. National Fire Protection Association (NFPA):

1. NFPA 80 - Standard for Fire Doors, Fire Windows.
2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

D. Steel Door Institute (SDI):

1. SDI 111 - Recommended Standard Details for Steel Doors & Frames.
2. SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.

E. Underwriters Laboratories Inc. (UL):

1. UL 10B - Fire Tests of Door Assemblies.
2. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

1.3 SUBMITTALS

A. No Product Data or Manufacturer Installation Instructions submittals required unless products and systems used deviate from those indicated in Part 2 of this Section and from Proposed Products List required in Section 01 33 00.

B. If submittal is required due to product deviation, submit the following items under provisions of Section 01 33 00.

C. Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.

D. Product Data: Submit frame configuration and finishes.

E. Manufacturer's Installation Instructions: Submit manufacturer’s installation instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.
2. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.

H. Provide documentation showing paints and coatings in accordance with 01 81 13 Sustainable Design Requirements.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of the state of California.

B. Fire Rated Frame Construction:

1. Conform to ASTM E152.

2. Smoke and draft control assemblies: Comply with UL 10B, Fire Tests of Door Assemblies. Label shall carry a supplemental “S” signifying smoke rating.

C. Installed Frame Assembly:

1. Conform to NFPA 80 for fire rated class same as fire door.

2. Smoke and draft assemblies: Comply with UL 10B, Fire Tests of Door Assemblies, and installation instructions for listed assembly.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1- Product Requirements: Product storage and handling requirements.

B. Accept frames on site in manufacturer's packaging. Inspect for damage.

C. Break seal on-site to permit ventilation.

1.7 COORDINATION

A. Division 1– Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with frame opening construction, door, and hardware installation.

C. Sequence installation to accommodate required door hardware electric wire connections.

PART 2 – PRODUCTS

2.1 STANDARD STEEL FRAMES

A. Manufacturers: Furnish compliant products of one of the following or approved equal:

1. Curries Company

2. Door Components, Incorporated.

3. Steelcraft.

4. Stiles Custom Metal, Incorporated.

B. Product Description: Standard shop fabricated steel frames, fire rated and non-rated types. Cold-rolled or hot-rolled steel sheet; not less than 14-gauge.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

2.3 ACCESSORIES

A. Removable Stops: Rolled steel channel shape, butted corners; prepared for countersink style tamper proof screws.

B. Mullion Stirrups and Clips: Manufacturer's standard to suit mullion profile.

C. Bituminous Coating: Non-asbestos fibered asphalt emulsion.

D. Primer: Primer compatible with finish paint system. ANSI A250.10 rust inhibitive type.

E. Silencers: Specified in Section 08 71 00.

F. Weatherstripping: Specified in Section 08 71 00.

2.4 FABRICATION

A. Provide welded units with integral trim, of sizes and shapes shown. Knocked-down frames not accepted.

B. Transom Bars for Glazed Lights: Of same profiles as jamb and head.

C. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.

D. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

E. Prepare frames for silencers. Omit at fire-rated doors.

F. Fabricate fire rated and smoke and draft assembly metal frames of materials in accordance with requirements of the listing label. Place labels where visible when frames are installed in position. Refer to Drawings for rating requirements.

G. Finished Work: Strong and rigid, neat in appearance, square, true and free of defects, warp or buckle. Fabricate molded members clean cut, straight and of uniform profile throughout their lengths.

H. Jamb Depths, Trim, Profile, Returns, and Backbends: Depths and profiles shown. Double return backbends typical.

I. Corner Joints: Solid interlocking with 16 gauge concealed corner clip reinforcing. Close contact edges tight, hairline miter edges, and butt stops.

J. Stops: Minimum depth 5/8-inches and as shown.

K. Hardware Reinforcements:

1. General: Mortise, reinforce, drill, and tap frames at factory for fully templated mortised hardware only, per hardware schedule and templates provided by hardware supplier. Where surface-mounted hardware is to be applied, provide frames with reinforcing plates only.

2. Hardware Reinforcing Plates: Minimum thickness as follows:

a. Hinge And Pivot Reinforcements: 7-gauge, 1-1/4 foot by 10-inches, minimum size.

b. Strike Reinforcements: 12 gauge.

c. Flush Bolt Reinforcements: 12 gauge.

d. Closer Reinforcements: 12 gauge.

e. Surface-Mounted Hardware Reinforcements: 12 gauge.

f. Hold-Open Arm Reinforcements: 12 gauge.

g. Surface Exit Device Reinforcements: 12 gauge.

L. Floor Anchors:

1. General: Securely weld inside each jamb, with minimum two holes provided at each jamb for base anchorage.

2. Adjustable Anchors: Where so scheduled or specified, provide adjustable floor anchors, not less than 2 inches in height adjustment.

3. Thickness: Minimum 14 gauge.

M. Jamb Anchors:

1. Stud Partitions: Provide frames with steel anchors of suitable design, not less than 16-gauge thickness, securely welded inside each jamb as follows:

a. Frames up to 7'-6" height: 4 anchors.

b. Frames 7'-6" to 8'-0" height: 5 anchors.

c. Frames over 8'-0" height: 5 anchors plus one additional for each 2'-0” or fraction thereof over 8'-0".

N. Steel Spreader: Provide frames with steel spreader attached to feet of both jambs to serve as temporarily brace during installation.

O. Loose Glazing Stops: Cold rolled steel, not less than 20-gauge thickness, butt at corner joints and secure to frame with counter-sunk cadmium- or zinc-plated screws.

2.5 SHOP FINISHING

A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, “Solvent Cleaning”; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, form uncoated steel, complying with SSPC-SP 3, “Power Tool Cleaning”, or SSPC-SP 6/NACE No. 3 “Commercial Blast Cleaning”.

B. Factory Priming for Field-Painted Finish: Apply manufacturer’s standard rust-inhibitive primer immediately after surface preparation and pretreatment. Apply primer to a uniform dry film thickness of not less than 0.7-mils. Fully cure before shipment.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Coordination and project conditions.

B. Verify opening sizes and tolerances are acceptable.

C. Verification of Conditions: Examine substrate and conditions under which hollow metal frames are to be installed and give notification, in writing, of any conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install frames in accordance with ANSI A250.8 and NFPA 80 for fire rated frames.

1. Install smoke and draft control assemblies in accord with the requirements of the label.

2. Install frames in accordance with manufacturer’s printed instructions for fire rated frames.

B. Coordinate with gypsum board wall construction for anchor placement.

C. Setting: Exercise care in setting of frames to maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.

D. Anchorages and Connections: Secure to adjacent construction. Furnish anchors to suit wall conditions or clips welded to frame for fastening to structure.

E. Spreader Bars: Whenever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached.

F. Expansion Movement: Allow for as required.

G. Coordinate installation of glass and glazing specified in Section 08 80 00.

H. Coordinate installation of frames with installation of hardware specified in Section 08 71 00.

I. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure.

J. Ensure that frames are securely and rigidly anchored to adjacent construction.

K. Install side light and window frames with formed glass stops on room side. Coordinate the installation of glass and glazing.

L. After installation, touch up scratched or damaged surfaces. Use type of primer identical to that used for shop coat.

3.3 ERECTION TOLERANCES

A. Division 1 - Quality Requirements: Tolerances.

B. Maximum Diagonal Distortion: 1/8 inch measured with straight edges, crossed corner to corner.

3.4 FIELD FINISHING

A. General: Immediately after installation remove rust, sand smooth, and touch-up items with prime coat which has been damaged with same primer as applied in shop. Meet all local VOC regulations.

B. Finish Painting: High Performance Coating. Apply finish paint per Section 09 96 00.

C. Color: Valspar, Fluropon Classic as noted on drawings.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes aluminum frames for interior doors and windows.

B. Related Sections:

1. Section 08 14 16 – Flush Wood Doors.
2. Section 08 71 00 – Door Hardware.
3. Section 08 80 00 – Glazing.
4. Section 09 21 16 – Gypsum Board Assemblies: Rough opening framing in compliance with frame manufacturer's recommendations.

1.2 REFERENCES

A. Aluminum Association (AA)

1. AA DAF-45 – Designation System for Aluminum Finishes

B. American Architectural Manufacturers Association (AAMA)

1. AAMA 611 – Voluntary Specification for Anodized Architectural Aluminum.

C. ASTM International

1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

D. National Fire Protection Association (NFPA):

1. NFPA 80 - Standard for Fire Doors and Fire Windows.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

B. Product Data: Include typical details, material descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

C. Manufacturer's Installation Instructions: Include rough opening framing recommendations.

D. Shop Drawings: Indicate frame elevations, reinforcement, anchorage and spacing, location of cut-outs for hardware, and finish.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Samples:

1. Submit 12 x 12 inches in size illustrating each type of specified finished aluminum surface.

2. Submit 12-inch length of frame profile in any throat size and finish. Division 1 criteria for sample quantity do not apply: one sample required only.

G. Provide documentation showing paints and coatings in accordance with 01 81 13 Sustainable Design Requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer and Installer: Companies specializing in manufacturing and installing aluminum door and glazing frame systems with minimum five years' experience.

B. Fire-Rated Assemblies: Whenever a fire-resistance classification is indicated, provide fire-rated frames investigated, tested, and labeled as part of a fire door or fire window assembly to certify compliance with the requirements of UL 10C Positive Pressure Test for specified exposure by an agency acceptable to governing authorities.

1. Labels: Provide labels permanently fastened on each fire rated frame that are within size limits established by NFPA and the testing authority.

2. Installation: Install assemblies in compliance with NFPA 80 and as specified herein.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Package interior aluminum frames work in cardboard or other containers with separators, banding, spreaders, and paper wrappings to protect items during transit and Project site storage.

B. Identification: Mark frame, on a surface which will be hidden after installation, with designation of opening for which it is furnished.

1.6 COORDINATION

A. Hardware Suppliers: Furnish interior aluminum frame manufacturer with accepted hardware schedule, hardware templates, and samples of physical hardware where necessary to ensure correct fitting and installation.

1.7 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Product warranties and product bonds. Warranties shall pay for all costs associated with repairs and replacement upon notification of defects.

B. Material Warranty: Provide material manufacturer's product warranty for a minimum of two (2) years from date of Substantial Completion.

C. Material Warranty: Provide material manufacturer's product warranty that finish will not contain defects including cracking, flaking, blistering, peeling and excessive fading,

chalking and non-uniformity in color for a minimum of five (5) years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 ALUMINUM DOOR AND GLAZING FRAMES

A. Manufacturers: Provide compliant products of one of the following or approved equal.

1. Frameworks / Assa Abloy.
2. RACO Interior Products, Incorporated.
3. Wilson Partitions.

B. Product Description: Wilson Partitions' "Series 200" is the Basis of the Specification. Extruded aluminum frames, non-rated and rated, either fabricated to required throat sizes or furnished with expandable throat to required sizes. Snap-on rectilinear trim with 1-1/2 inch wide flush profile. Frame shall accept 3/8 inch laminated glass.

2.2 COMPONENTS

A. Aluminum: ASTM B221; 6063 alloy, T5 temper. Not less than 25 percent pre-consumer recycled content.

B. Fasteners: Aluminum, nonmagnetic, stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

C. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals.

D. Glazing Gaskets: Manufacturer's standard extruded or molded plastic, to accommodate glazing thickness indicated. Color to be black.

E. Glass: As indicated on Drawings and specified in Section 08 80 00. Glazing sealants to be grey.

F. Hardware: As specified in Section 08 71 00.

2.3 FABRICATION

A. Pre-machine jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required, and fastened within the frame.

B. Provide corner reinforcements and alignment clips for precise butt or mitered connections.

C. Fabricate all components to allow secure installation without exposed fasteners.

D. Fabricate kits for glazing with removable stops to allow glazing replacement without dismantling.

E. Manufacturer shall pre-cut and ship all frame materials knock-down.

2.4 ALUMINUM FINISHES

A. High-Performance Organic Finish – Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Color: Match Glazed Aluminum Curtainwall as specified in Section 08 44 13.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Coordination and project conditions.

B. Examine project conditions and verify that the work of this section may properly commence. Do not proceed with the installation until unsatisfactory conditions have been corrected.

C. Verify that the wall thickness does not exceed manufacturer’s recommended tolerances of specified frame throat size.

3.2 INSTALLATION

A. Comply with frame manufacturer’s printed installation instructions and approved shop drawings. Strictly adhere to maintaining specified wall thickness to insure dimension does not exceed frame throat size specified.

B. Install frames plumb and square, free from warp or twist. Securely anchor to substrates with fasteners recommended by frame manufacturer.

1. Use concealed installation clips to assure that splices and connections are tightly butted and properly aligned.

2. Secure clips to main structural extrusion components and not to snap-in or trim members.

3. Do not use screws or other fasteners that will be exposed to view when installation is complete.

4. Maintain dimensional tolerances and alignment with adjacent work. Ensure hairline joints and flush surfaces and with adjacent aluminum components.

3.3 CLEANING AND ADJUSTMENT

A. Division 1 – Execution and Closeout Requirements: Requirements for cleaning.

B. Clean work in accordance with manufacturer’s recommendations.

C. Touch up marred areas so that touch-up is not visible from a distance of 4 feet. Remove and replace frames that cannot be satisfactorily adjusted.

3.4 PROTECTION

A. Protect installed work against damage from other construction work.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes provision of steel doors of types noted and installation of their hardware.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 08 12 14 - Standard Steel Frames.
3. Section 08 71 00 - Door Hardware.
4. Section 08 80 00 - Glazing: Glass for doors.
5. Section 09 90 00 - Painting and Coating: Field painting of doors.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A250.8 / SDI 100 - Recommended Specifications for Standard Steel Doors and Frames.

B. ASTM International (ASTM):

1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM C1363 - Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

D. National Fire Protection Association (NFPA):

1. NFPA 80 - Standard for Fire Doors, Fire Windows.
2. NFPA 105 – Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives.
3. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

E. Underwriters Laboratories Inc. (UL):

1. UL - Building Materials Directory.

2. UL 10B - Fire Tests of Door Assemblies.
3. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
4. UL 1784 - Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate door elevations, internal reinforcement, closure method, and cut-outs for glazing, louvers, and finishes.

C. Product Data: Submit door configurations, location of cut-outs for hardware reinforcement.

D. Manufacturer's Installation Instructions: Submit special installation instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.
   a. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.
2. Indoor Environmental Quality Certificate: Certify adhesives, sealants, and core material comply with emissions criteria.

G. Provide documentation showing paints and coatings in accordance with 01 81 13 Sustainable Design Requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI A250.8.

B. Steel doors shall be the product of the same manufacturer to insure uniformity of quality and appearance throughout the project.

C. Fire Rated Door Construction:

1. 20-Minute Fire-Rated Corridor Doors: As part of a fire tested assembly in accordance with NFPA 252 or UL 10C without the hose stream test. Assembly shall be gasketed and meet smoke and draft control requirements in accordance with UL 1784.
2. 45-Minute Special Use Room Doors: As part of a fire tested assembly in accordance with NFPA 252, UL 10B or UL 10C with the hose stream test.
3. 60- and 90-Minute Exit Stair and Exit Passageway Doors: As part of a fire tested assembly in accordance with NFPA 252 or UL 10C with the hose stream test.

D. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

E. Installed Smoke and Draft Control Door Assembly: Conform to NFPA 105.

F. Attach WH-Certification or label from other agency approved by authority having jurisdiction to identify each fire rated door.

1. Smoke and Draft Control Door Assemblies: Include the letter “S” on the label.

1.5 QUALIFICATIONS

A. Manufacturer and Installer: Companies specializing in manufacturing and installing products specified in this section with minimum three years’ documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Do not store in damp or wet areas. Break seal on site to permit ventilation.

1.7 COORDINATION

A. Division 1 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work with door opening construction, door frame, and door hardware installation.

C. Coordinate installation to accommodate door hardware electric wire connections.

PART 2 – PRODUCTS

2.1 STANDARD STEEL DOORS

A. Manufacturers: Furnish compliant products of one of the following or approved equal:

1. Curries Company
2. Door Components, Incorporated.
3. Steelcraft.
4. Stiles Custom Metal, Incorporated.

B. Product Description:

1. Exterior Doors (Insulated): ANSI/SDI A250.8, SDI 108, 1-3/4 inch thick, shop primed. Fire rated and non-fire rated types.
    a. Level 3 and Physical Performance Level A – Extra Heavy Duty, Model 2 - seamless design.
    b. Galvanized steel sheet faces, end closures, and internal components.
2. Interior Doors: ANSI/SDI A250.8, SDI 108, 1-3/4 inch thick, shop primed. Fire rated and non-fire rated types.
    a. Level 2 and Physical Performance Level B – Heavy Duty, Model 2, seamless design.
    b. Cold-rolled steel sheet faces, end closures, and internal components.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

C. Indoor Environmental Quality Characteristics:

1. Volatile Organic Compounds: Furnish sealants, adhesives, and field-applied finishes that do not exceed VOC limits required in Section 01 81 13.
2. Urea-Formaldehyde: Do not use composite wood and agrifiber products that contain urea-formadehyde resin.

2.3 COMPONENTS

A. Face: Steel sheet in accordance with ANSI A250.8/SDI 100.

B. End Closure: Cold-rolled channel, flush orientation.

C. Core: Chemically-inert, moisture-resistant as recommended by door manufacturer.

D. Thermal Insulated Door: Total insulation minimum R-Value of 2.4, measured in accordance with ASTM C1363.

E. Glass: Meeting requirements specified in this section, as scheduled on Drawings and specified in Section 08 80 00, minimum required thickness. Glass size shall not exceed that tested for fire-rated door assemblies.

2.4 ACCESSORIES

A. Removable Glazing Stops: Rolled steel, channel shape, mitered corners; prepared for countersink style tamper proof screws.

2.5 FABRICATION

A. Fabricate doors with hardware reinforcement welded in place.

2.6 SHOP FINISHING

A. Steel Sheet: Galvanized to ASTM A653 G60 or G90.

B. Primer: ANSI A250.10 rust inhibitive type.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install doors in accordance with ANSI A250.8.

1. Install smoke and draft control assemblies in accordance with NFPA 105.

2. Install fire-rated doors in accordance with NFPA 80.

B. Coordinate installation of glass and glazing specified in Section 08 80 00.

C. Coordinate installation of doors with installation of frames specified in Section 08 12 14 and hardware specified in Section 08 71 00.

3.3 ERECTION TOLERANCES

A. Division 1 - Quality Requirements: Tolerances.

B. Maximum Diagonal Distortion: 1/8 inch measured with straight edge, corner to corner.

3.4 FIELD FINISHING

A. General: Immediately after installation remove rust, sand smooth, and touch-up items with prime coat which has been damaged with same primer as applied in shop. Meet all local VOC regulations.

B. Finish Painting: High Performance coating. Valspar, Fluropon Classic. Color as noted on drawings. Apply finish paint per Section 09 96 00.

3.5 ADJUSTING

A. Division 1 - Execution and Closeout Requirements: Requirements for adjusting.

B. Adjust door for smooth and balanced door movement.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes non-rated and fire-rated flush wood doors.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 08 12 14 – Standard Steel Frames.
3. Section 08 71 00 - Door Hardware.
4. Section 08 80 00 – Glazing.

1.2 REFERENCES

A. AWI Architectural Woodwork Institute:

1. AWS – Architectural Woodwork Standards

B. FSC (Forest Stewardship Council): Guidelines for environmentally certified doors.

C. Hardwood Plywood and Veneer Association:

1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

D. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

E. National Fire Protection Association:

1. NFPA 80 - Standard for Fire Doors, Fire Windows.
2. NFPA 105 – Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives.
3. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

F. Underwriters Laboratories Inc.:

1. UL - Building Materials Directory.
2. UL 10B - Fire Tests of Door Assemblies.
3. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
4. UL 1784 - Air Leakage Tests of Door Assemblies.

G. Window and Door Manufacturers' Association.

1. WDMA I.S. 1-A – Architectural Wood Flush Doors.

1.3 SUBMITTALS

A. Submit the following items under provisions of Division 1 - Submittals.

B. Submit door manufacturer's product construction data, hardware attachment performance data, specifications and installation instructions for each type of wood door, including details of core and edge construction, facing materials, trim for lite openings and similar components.

C. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificates: Certify chain of custody for products containing certified wood.

D. Samples:

1. Submit two samples of door veneer face, 12 x 12 inch in size illustrating wood grain, factory finish.

1.4 QUALITY ASSURANCE

A. Wood doors shall be the product of the same manufacturer to insure uniformity of quality and appearance throughout the project.

B. Fire Rated Door Construction:

1. 20-Minute Fire-Rated Corridor Doors: As part of a fire tested assembly in accordance with NFPA 252 or UL 10C without the hose stream test. Assembly shall be gasketed and meet smoke and draft control requirements in accordance with UL 1784.

2. 45-Minute Special Use Room Doors: As part of a fire tested assembly in accordance with NFPA 252, UL 10B or UL 10C with the hose stream test.

3. 60- and 90-Minute Exit Stair and Exit Passageway Doors: As part of a fire tested assembly in accordance with NFPA 252 or UL 10C with the hose stream test.

C. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

D. Installed Smoke and Draft Control Door Assembly: Conform to NFPA 105.

E. Attach WH-Certification or label from other agency approved by authority having jurisdiction to identify each fire rated door.

1. Smoke and Draft Control Door Assemblies: Include the letter "S" on the label.

F. Door components shall contain no added urea formaldehyde.

1.5 QUALIFICATIONS

A. Door Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Product storage and handling requirements.

B. Package, deliver and store doors in accordance with AWI AWS Section 2.

C. Building HVAC system shall be operating. Temperature to be in range of 50 - 90 degrees F. Humidity to be in range of 30 - 50 percent relative.

D. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges when stored more than one week.

E. Break seal on site to permit ventilation.

1.7 COORDINATION

A. Division 1 – Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with door opening construction, door frame and door hardware installation.

1.8 WARRANTY

A. Division 1 - Warranties: Product warranties and product bonds.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

C. Furnish manufacturer’s “Life of Installation” warranty for interior doors.

PART 2 – PRODUCTS

2.1 FLUSH WOOD DOORS

A. Manufacturers: Furnish products of one of the following or approved equal:

1. Lynden Door Incorporated.
2. Masonite Architectural.
3. Oshkosh Door Company.
4. VT Industries, Incorporated.

B. Product Description: WDMA I.S. 1A and AWI/AWS Section 9 Premium Grade solid core flush wood doors. Five-ply construction, 1-3/4 inches thick, wood veneer or high

pressure decorative laminate (HPDL) facing material as specified in Components, fire rated and non-fire rated types, flush glazed design, factory pre-fit, shop finished.

2.2 COMPONENTS

A. Core:

1. Non-Rated and 20 Minute Fire Rated: Type SCL – FSC Structural Composite Lumber Core.

2. 45 Minute, 60 Minute, and 90 Minute Hour Fire-Rated: Mineral Core conforming to the requirements of the applicable labeling agency acceptable to the Authority Having Jurisdiction for the label specified.

B. Veneer Facing:

1. Cross Banding: One ply of manufacturer's standard construction.

2. Facing: FSC Wood veneer for transparent finish.

a. Grade: HPVA HP-1, AA-Grade.

b. Species: White Birch

c. Veneer Cut: Quarter cut.

d. Veneer Matching: Slip matched.

e. Face Matching: Center balanced. Pair match multiple door leaves in single opening.

3. Facing Adhesive: Type I – Waterproof.

C. Glazing Stops: Wood with mitered corners. Furnish metal clips for rated doors. Prepare for countersunk style tamper-proof screws.

D. Glass: Meeting requirements specified in this section, as scheduled on Drawings and specified in Section 08 80 00, minimum required thickness. Glass size shall not exceed that tested for fire-rated door assemblies.

2.2 DOOR FABRICATION

A. Fabricate doors in accordance with AWI requirements.

B. Where necessary for core type, furnish 5 inch high solid blocking rails at top and bottom edges for hardware reinforcement. Furnish lock blocks at lock edge for hardware reinforcement.

C. Vertical Exposed Edge of Stiles: Of same species as veneer facing. Hardwood for transparent finish.

D. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Furnish solid blocking for through bolted hardware.

E. Factory fit doors for frame opening dimensions identified on shop drawings.

F. Provide edge clearances in accordance with AWI AWS Section 9.

2.3 DOOR SHOP FINISHING

A. Finish work in accordance with WDMA I.S. 1A.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Coordination and project conditions.

B. Verify opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install doors in accordance with AWI AWS Section 9 and manufacturer's instructions.

B. Trim non-rated door width by cutting equally on both jamb edges. Trim door height by cutting bottom edges to maximum of 3/4 inch.

C. Coordinate installation of doors with installation of frames and hardware specified in Section 08 71 00.

3.3 INSTALLATION TOLERANCES

A. Division 1 - Quality Requirements: Tolerances.

B. Conform to AWI requirements for fit and clearance tolerances.

C. Maximum Diagonal Distortion (Warp): 1/4 inch measured with straight edge or taut string, corner to corner, over imaginary 36 x 84 inches surface area.

D. Maximum Vertical Distortion (Bow): 1/8 inch measured with straight edge or taut string, top to bottom, over imaginary 36 x 84 inches surface area.

E. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taut string, edge to edge, over imaginary 36 x 84 inches surface area.

3.4 ADJUSTING

A. Division 1 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust door for smooth and balanced door movement.

C. Adjust closer for full closure.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Smoke detector activated elevator door smoke containment curtain and control system designed to provide a tight-fitting, smoke-and draft-control assembly.

1.02 RELATED SECTIONS

A. Section 09 25 00 – Gypsum Board: Metal backing in housing mounting area.

B. Section 09 90 00 – Painting: Field painting of specified components.

C. Division 16 – Electrical: Power and control circuit power including conduit, boxes, conductors, wiring devices, and emergency power.

D. Division 16 – Electrical: Provision of smoke detectors, connections to fire detection system, and installation of end-of-line diode (3.9V, 2W) at smoke detector to monitor the circuit.

1.03 REFERENCES

A. ASTM A240/240M – Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

B. ICC-ES AC77 – Acceptance Criteria for Smoke-Containment Systems Used With Fire-Resistive Elevator Hoistway Doors and Frames.

C. ICC-ES Legacy Report ER 4968.

D. NFPA Codes and Standards:

1. 70 – National Electrical Code.

2. 105 – Recommended Practice for the Installation of Smoke-Control Door Assemblies.

3. 72 – National Fire Alarm Code.

E. CBC 2019 Standard 7.210 (Part II) Test Standard for Smoke and draft control assemblies of the International Conference of Building Officials.

F. UL Standards:

1. 268 – Smoke Detectors for Fire Protective Signaling Systems.

2. 508 – Industrial Control Equipment.

3. 864 – Control Units for Fire Protective Signaling Systems.

4. 1784 – Air Leakage Tests for Door Assemblies.

G. ICC-ES Legacy Report NER 637

1.04 SUBMITTALS

A. Submit under provisions of Section 01330.

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: Include door width and height, jamb width, jamb and head projection, curtain width, mounting height, and housing width. Show and identify related work performed under other sections of the specifications.

D. Selection Samples: Color charts representing manufacturer's full range of available colors and patterns.

E. Maintenance Instructions: Comply with Section 01700.

1. Manufacturer’s installation instructions and testing procedures.

2. Manufacturer’s operation and maintenance manual.

F. Certifications: Copy of specified items.

G. Warranties: Copies of manufacturer’s warranties.

1.05 QUALITY ASSURANCE

A. Overall Standards: Manufacturer shall maintain a quality control program in accordance with ICBO-ES Acceptance Criteria AC 77.

B. Qualifications:

1. Manufacturer Qualifications: Minimum seven years experience in producing smoke containment systems of the type specified.

2. Installer Qualifications: Factory trained by manufacturer.

C. Certifications

1. Manufacturer’s ICC-ES Legacy Report 4968.

2. California Office of the State Fire Marshal Listing.

3. Testing Laboratory Label.

4. UL Listing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Follow manufacturer’s instructions.

1.07 WARRANTY

A. Provide manufacturer’s standard one year warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Smoke Guard Corporation “Model 600”. Substitutions not permitted (no known equal).

1. Verify width of elevator door openings.

2.02 PERFORMANCE REQUIREMENTS

A. Air Leakage: Not to exceed 3 cfm per square foot of door opening at 0.1 inch water pressure differential at ambient temperature and 400 degree F tested per 1998 California Building Code/UBC Standard 7-2.

2.03 MATERIALS

A. Curtain:

1. Film: Minimum 1 mil thick transparent polyimide film reinforced with minimum 100 denier Nomex yarn at 0.25 in each way.

2. Magnetic Strips: Flexible multi-pole strips attached to longitudinal edges of film with low modulus silicone adhesive.

B. Housing: 20 gauge, powder coated, cold rolled steel container with dust cover and door with concealed hinges. Housings are 55 inches or 64 inches in length, plus 1-1/2 inches for a junction box on the left side.

C. Rewind Motor: NFPA 70, 90V DC.

D. Release Mechanism: Comply with UL Standard No. 864.

E. Screen Rewind Switch: Include switch to rewind curtain into housing.

F. Label each smoke containment system with following information:

1. Manufacturer’s name.

2. Maximum leakage rating at specified pressure and temperature conditions.

3. Label of quality control agency.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared. Notify Architect of satisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Protect adjacent surfaces from damage due to installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.04 FIELD QUALITY CONTROL

A. Field Test: Follow manufacturer’s cycle test procedures.

1. Notify Owner’s Representative, local Fire Marshal, Contractor, fire alarm sub-contractor and elevator service company minimum 5 working days in advance of scheduled testing.

2. Demonstrate operation of all installed containment curtains and control systems to the satisfaction of all notified parties.

3. Complete maintenance service record.

3.05 CLEANING

1. Reference Section 01700 – Execution.

3.06 DEMONSTRATION

1. Demonstrate required testing and maintenance procedures to Owner's Representative.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes fire-rated and non-rated service access doors and panels in walls and ceilings.

1. Provide for access to controls, valves, traps, dampers, cleanouts, and similar items requiring operation behind inaccessible finished surfaces, whether shown or not.

2. Provide at other locations as shown.

3. Coordinate exact locations with various trades to assure proper placement of access doors and panels.

4. Refer to Part 3 for application Schedule.

B. Related Sections:

1. Section 09 21 16 – Gypsum Board Assemblies: Furnishing rough openings for access doors and frames.

2. Section 09 90 00 - Painting and Coating: Field paint finish.

3. Division 21 – Fire Protection: Furnishing access doors as required. Types as described in this Section.

4. Division 22 – Plumbing: Furnishing access doors as required. Types as described in this Section.

5. Division 23 – Heating, Ventilating and Air Conditioning: Furnishing access doors as required. Types as described in this Section.

6. Division 26 – Electrical: Furnishing access doors as required. Types as described in this Section.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM E119: Standard Test Methods for Fire Tests of Building Construction and Materials.

B. California Building Code (CBC) 2010.

C. Intertek Testing Services (Warnock Hersey Listed) (WH):

1. Certification Listings.

D. National Fire Protection Association (NFPA):

1. NFPA 80 - Standard for Fire Doors, Fire Windows.

E. Underwriters Laboratories Inc. (UL):

1. UL - Building Materials Directory.

1.3 SUBMITTALS

A. Submit following items under provisions of Division 1.

B. Product Data: Submit literature indicating sizes, types, finishes, hardware, scheduled locations, fire resistance listings, and details of adjoining Work.

1.4 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of access units.

1.5 QUALITY ASSURANCE

A. Conform to CBC for fire rated access units.

B. Fire Resistance Ratings: Where indicated as fire rated assemblies from manufacturers listed in UL Directory or Intertek Testing Services (Warnock Hersey Listed) Directory.

C. Fire Rated Horizontal Access Doors: Rating as indicated on Drawings.

1. Tested Rating: Determined in accordance with ASTM E119.

D. Attach label from agency approved by authority having jurisdiction to identify each fire rated access door.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified with minimum three years documented experience, and with service facilities within 100 miles of Project.

1.7 COORDINATION

A. Division 1 – Administrative Procedures: Requirements for coordination.

B. Coordinate Work with work requiring controls, valves, traps, dampers, cleanouts, and similar items requiring operation being located behind finished surfaces.

PART 2 – PRODUCTS

2.1 ACCESS DOORS AND PANELS

A. Manufacturers: Furnish compliant products of one or more of the following or approved equal. Furnish single manufacturer per classification of access door or panel.

1. Bauco Access Panel Solutions, Inc.
2. Karp Associates, Incorporated.
3. J.L. Industries / Activar Incorporated.
4. Nystrom Products Company.
5. Milcor LTD, Partnership.

B. Product Descriptions: Products of Karp Associates, Inc. are referenced in each product classification as the basis of the specification, except as noted.

1. Flanged Stainless – Non-Rated: Stainless steel door and 16 gauge frame with flanges flush to door face. Basis of Specification: "DSC-214M".
2. Flanged Stainless – Fire Rated: Stainless steel, self-closing and self-latching door and 16 gauge frame with UL label valid for two-hour wall assembly. Basis of Specification: "KRP-250FR".
3. Concealed Flange Steel – Non-Rated: 16 gauge, galvanized beaded frame for embedment in drywall compound for concealment. Factory primed for field painting. Basis of Specification: "KDW".
4. Concealed Flange Steel - Rated: 16 gauge, galvanized beaded frame for embedment in drywall compound for concealment. UL label valid for two-hour wall assembly. Self-closing, self-latching steel door. Factory primed for field painting. Basis of Specification: "KRP-350FR".
5. Concealed Flange Drywall – Non-Rated Acoustical: Concealed hinge and 5/8-inch moisture-resistant gypsum board inlay for flush installation, recessed aluminum frame. Installation shall result in approximately 1/8-inch flush drywall gap all around. Basis of Specification: Bauco Access Panel's "baucoplus-II" series.

2.2 FABRICATION

A. Fabricate units of continuous welded construction; weld, fill, and grind joints to assure flush and square unit.

B. Wall and Ceiling Access Door and Panel Hardware:

1. Hinge: Standard continuous or concealed spring pin type, 175 degree steel hinges. Finish to match door and frame. Fire rated doors shall be self-closing.
2. Lock: Furnish all steel access doors and panels with keyed cylinder lock, all keyed alike. Fire rated doors shall be self-latching.

C. Size Variations: Obtain acceptance of manufacturer's standard size units which vary slightly from sizes shown or scheduled on Drawings.

D. Finish:

1. Stainless: No. 4.

2. Steel: Factory primed for field painting.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Procedures: Coordination and project conditions.

B. Verify rough openings for access doors and panels are correctly sized and located.

3.2 INSTALLATION – STEEL ACCESS DOORS

A. Secure frames rigidly in place, plumb and level in opening, with plane of door and frame face nominally aligned with adjacent finished surfaces.

B. Position unit to provide convenient access to concealed work requiring access.

C. Install fire rated units in accordance with NFPA 80 and requirements for fire listing. Line rough opening with gypsum board.

D. Paint factory primed doors to match adjacent gypsum board surface.

3.3. INSTALLATION – CONCEALED FLANGE DRYWALL ACCESS DOORS

A. Install panel finish flush with adjacent gypsum board ceiling surface. Fasten frame securely into rough opening per manufacturer's recommendations.

B. Tape, fill and sand smooth edges of frame to adjacent gypsum board for continuous appearance.

C. Paint to match adjacent gypsum board surface.

3.4 INSTALLATION SCHEDULE

A. General: Furnish access panel and door product classifications as follows:

1. Ceramic Tile Walls: Flanged Stainless. Furnish fire-rated where installed in fire rated partitions and walls.

2. Gypsum Board Walls: Concealed Flange Steel, field painted to match adjacent surface. Furnish fire-rated where installed in fire rated partitions and walls.

3. Gypsum Board Walls and Ceilings, Non-Rated Acoustical: Concealed Flange Drywall, field finished to match adjacent surface.

4. Gypsum Board Ceilings – Rated: Concealed Flange Steel, fire-rated, field painted to match adjacent surface.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes motor-operated overhead coiling door assemblies and operating hardware.

1. Provide anchorages and inserts as required for mounting and anchoring.

B. Related Sections:

1. Section 05 50 00 – Metal Fabrications: Provision of structural supports, **jamb and head sheet metal trim.**

2. Section 08 71 00 – Hardware: Product Requirements for cylinder core and keys for placement by this Section.

3. Section 09 90 00 Painting and Coating

4. Division 26 - Electrical **wiring and conduit, fuses, disconnect switches, connection of operator to power supply, and installation of control station and wiring**.

C. **Products That May Be Supplied, But Are Not Installed Under This Section:**

1. Control Station

1.2 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

1. ASHRAE Handbook – Fundamentals.

B. ASTM International:

1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories (UL):

1. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.3 PERFORMANCE REQUIREMENTS

A. Wind Loads: Design door assembly to withstand positive and negative wind load as determined in conformance with given wind load criteria identified in Structural Drawings, with maximum deflection of 1/120, and without damage to door or assembly components.

B. Seismic Performance: Overhead coiling doors are to withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Operation: Design door assembly to operate for not less than 50,000 cycles.

1.4 SUBMITTALS

A. Division 1 – Submittal Procedures: Submittal procedures.

B. Product Data: Submit general construction, component connections and details.

1. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, and adjustment and alignment procedures.

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

1. Reference each door using Opening Number identified in the Drawings.

D. Maintenance and Operating Manuals: Furnish complete manuals describing materials, devices, and procedures to be followed in operating and maintaining coiling doors. Include manufacturer’s brochures and parts lists describing actual materials used in the product.

E. Samples: Submit door slats, 12 inch x 12 inch in size illustrating shape, color and finish texture.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years’ experience.

B. Installer: Company specializing in performing work of this section with minimum three years’ experience and approved by the manufacturer.

C. Insulated Door Slat Material Requirements:

1. Maximum 10/50 flame spread/smoke developed index when tested in accordance with ASTM E84.

2. Minimum R-value of 6.2 as calculated according to ASHRAE.

3. Insulation to be CFC-free with an Ozone Depletion Potential rating of zero.

D. Provide each overhead coiling door as complete unit produced by single manufacturer, including hardware, accessories, mounting and installation components.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1 – Product Requirements.

B. Deliver, store, and handle items to prevent damage or deformation.

C. Deliver items only after proper facilities are available. Do not discharge or store materials on ground.

D. Store delivered products undercover and in clean, safe, dry surfaces or platform as required. Protect from deterioration and foreign matter.

1.7 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Requirements for warranties.

B. General: Warranties shall pay for all costs associated with repairs and replacement upon notification of defects.

C. Material Warranty: Provide material manufacturer's product warranty for a minimum of five (5) years from date of Substantial Completion. Shall include finish warranty against rust through, fading, peeling and chalking.

1. Motor Warranty: Provide two-year material warranty on operator motor and parts.

PART 2 – PRODUCTS

2.1 OVERHEAD COILING DOORS

A. Manufacturers: Provide compliant products of one of the following or approved equal:

1. The Cookson Company, Incorporated.
2. Lawrence Roll-Up Doors, Incorporated.
3. Overhead Door Corporation.

B. Product Description: Insulated, face of wall mounted, motorized service door. Basis of Specification: Cookson Company's "Thermiser Max" Model "ESD30".

2.2 COMPONENTS

A. Curtain: Conform to the following:

1. Steel Slats: Interlocking, minimum 22 gauge of Grade 40 ASTM A653 galvanized steel.
   a. Type: Sandwich slat construction with manufacturer's standard insulated core.
2. Bottom Bar: Two 1/8 inch steel angles mechanically joined together. Factory-applied baked on thermosetting powder coat to match finish indicated on curtain.

B. Guides: Minimum 3/16 inch thick steel angles, continuous, vertical mounted; steel mounting brackets.

C. Hood Enclosure and Fascia: Square Shape, minimum 24 gauge galvanized steel, internally reinforced to maintain rigidity and shape.

D. Electric Operator: UL 325, front of coil side mounted, totally enclosed, nonventilated or fan-cooled medium duty motor. Basis of Specification: Cookson Company "Model MG".

1. Motor Enclosure: NEMA MG1 Type 1 enclosure.
2. Motor Rating: 3/4 hp; continuous duty.
3. Motor Voltage: 230/460 volt, three phase, 60 hz.
4. Motor Controller NEMA ICS 2, full voltage, reversing magnetic motor starter.
5. Controller Enclosure: NEMA 250 Type 4.
6. Door Speed: 12 inches per second.
7. Brake: Adjustable friction clutch type, activated by motor controller.

F. Control Station: Standard three button (Open-Stop-Close) constant pressure control for each operator; 24 volt circuit, recessed.

G. Safety Edge: Manufacturer's standard safety edge and weatherseal located at door bottom, full width, sensitized type, wired to reverse upon striking object.

H. Emergency Chain Hoist: Provide manual chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide.

I. Weatherstripping:

1. Bottom Bar: Replaceable, bulb-style, compressible EDPM gasket extending into guides.

2. Guides: Replaceable vinyl strip on guides sealing against fascia side of curtain.

3. Hood: Neoprene/rayon baffle to impede air flow above coil.

2.3 ACCESSORIES

A. Locks: Manufacturer's standard cylinder dead lock on inside at door jamb, key operated from interior. Cylinder shall be master keyed.

B. Weatherstripping: Moisture and rot proof, resilient types for complete weathertight installation at bottom bar and guides at fascia side of curtain.

1. Include baffle to impede air flow seal between hood and lintel.

2.4 SHOP FINISHING

A. Curtain Slats – Galvanized Steel: Bonderized coating for prime coat adhesion to galvanized surface, and factory applied thermosetting powder coating applied with a minimum thickness of 2.5 mils. Custom color as selected by Architect.

B. Hood Enclosure, Fascia **and Jamb Trim** – **24 GA .**Galvanized Steel: Match curtain slat system and color. **Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets as required to prevent excessive sag.**

C. Steel Guides: Factory-applied baked on thermosetting powder coat to match finish indicated on curtain.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Coordination and project conditions.

B. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.

C. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install overhead coiling grilles in accordance with manufacturer's printed instructions and reviewed Shop Drawings.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00.

F. Install all weatherstripping.

3.3 ADJUSTING

A. Division 1 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust shutter, hardware, and operating assemblies for smooth and quiet operation.

C. Upon completion, ensure overhead coiling grilles are free from warp, twist, or distortion, and are lubricated and properly adjusted to operate freely.

3.4 CLEANING

A. Division 1 - Execution and Closeout Requirements: Final cleaning.

B. Thoroughly clean surfaces of grease, oil, and other impurities as recommended by manufacturer.

C. Remove labels and visible markings.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes design and provision of INTERIOR tubular aluminum-framed storefront systems, with or without supplementary internal support framing, operable window units where shown on Drawings, aluminum and glass entrance doors and frames, glass glazing, related flashings, anchorage and attachment devices.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 05 50 00 - Metal Fabrications: Steel fabricated attachment devices.
3. Section 07 42 43 – Composite Wall Panels: Infill panels in storefront.
4. Section 07 62 00 – Sheet Metal Flashing and Trim.
5. Section 07 90 00 - Joint Protection: System perimeter sealant and back-up materials.
6. Section 08 44 13 – Glazed Aluminum Curtain Walls.
7. Section 08 71 00 - Door Hardware.
8. Section 08 80 00 - Glazing.

1.2 REFERENCES

A. Aluminum Association:

1. AA ADM 1 - Aluminum Design Manual.

B. American Architectural Manufacturers Association/Window & Door Manufacturers Association:

1. AAMA/WDMA 101/I.S.2 - Specification for Windows, Doors and Unit Skylights.
2. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Glass Doors.
3. AAMA 503 - Voluntary Specification for Field Testing of Metal Storefronts. Curtain Wall and Sloped Glazing Systems.
4. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
5. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
6. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

7. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

8. AAMA SFM-1 - Aluminum Store Front and Entrance Manual.

C. American Society of Civil Engineers:

1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

4. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

5. 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.

6. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

7. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

8. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential.

9. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.

E. California Code of Regulations,Title 24, Part 1:

1. CAC – California Administrative Code

F. National Fenestration Rating Council Incorporated:

1. NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

G. SSPC: The Society for Protective Coatings:

1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

2. SSPC Paint 25 - Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer.

1.3 PERFORMANCE REQUIREMENTS

A. System Design: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners.

1. As calculated in accordance with the current version of the California Building Code, as tested in accordance with ASTM E330. Refer to Structural Drawings.

2. Safety Factor: Unless otherwise specified, design components, parts, and assemblies including glazing stops, gaskets, adhesives, and sealants for a safety factor not less than 1.5. Failure of any part or assembly not acceptable at less than 1.5 times design wind load pressure. Failure defined as breakage, disengagement, permanent deformation of framing members in excess of L/1000 or 1/64-inch of their clear span, whichever is less; or permanent deformation of anchor assemblies beyond tolerance and slippage limitations.

3. Deflection Normal to Wall Plane: Limit mullion deflection to 1/175 for spans under 13’-6” or 3/4 inch, whichever is less, except L/360 at members adjacent to plaster or gypsum board surfaces; with full recovery of glazing materials.

B. System Assembly: Accommodate without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.

C. Air Infiltration: Limit air leakage through assembly to 0.06 cfm/min/sq ft of wall area, measured at reference differential pressure across assembly of 6.24 psf as measured in accordance with AAMA/WDMA 101/I.S.2.

D. Expansion / Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over 12 hour period without causing detrimental effect to system components and anchorage.

E. System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.

F. Not Permitted: Assemblies shall be free from rattles, vibration harmonics, wind whistles, noises caused by thermal and structural movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of the system.

G. Design Modifications: Maintain general design concept without altering profiles or adversely affecting appearance, durability, or strength of materials. Modifications acceptable only as may be necessary to comply with design criteria. Submit variations in details and materials for review.

1.4 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

1. Provide stamped engineered drawings indicating system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details. Furnish elevations of each section of storefront and include details of each condition for each storefront section, indicating anchorages, sealant application, glazing system, integration of flashings specified elsewhere, and as required for proper fabrication, assembly, and installation.

2. Calculations: Submit stamped engineered calculations to substantiate shop drawing compliance with the specified design criteria.

    a. Design Data: Indicate framing member structural and physical characteristics, dimensional limitations.

B. Product Data: Submit component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.

C. Test Reports: Submit certified test reports showing compliance with specified Performance Requirements.

D. Samples: Submit 12 x 12 inches in size illustrating each type of finished aluminum surface, and glass glazing materials.

E. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.

    a. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.

2. Indoor Air Quality Certificates: Certify volatile organic compound content for each interior adhesive and sealant and related primer.

F. Provide documentation showing paints and coatings in accordance with 01 81 13 Sustainable Design Requirement.

1.5 QUALIFICATIONS

A. Manufacturer and Installer: Companies specializing in manufacturing and installing aluminum glazing systems with minimum three years experience.

1.6 PRE-INSTALLATION MEETINGS

A. Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner's representative, Architect, Contractor, and subcontractors whose work is relevant to this Specification Section.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Packing, Shipping, Handling, and Unloading: Deliver units and accessories in manufacturer's original packaging, clearly identified with manufacturer's name and type of product, finish, and installation location.

B. Storage and Protection: Store in the original packaging, indoors, in an upright position, protected from damage. Handle in a manner to prevent twisting and other damage.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install sealants nor glazing materials when ambient temperature is less than 40 degrees F during and 48 hours after installation.

1.9 COORDINATION

A. Coordinate the Work with installation of metal flashings, air and weather barriers, automatic entrance doors, and door hardware components or materials.

1.10 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Product warranties and product bonds. Contractor shall make repairs and replacements upon notification of defects.

1. Assembly: Warrant for 10 years against excessive deflection, water penetration and failure of operable components.

2. Finishes: Warrant for 20 years against excessive deterioration of finishes.

PART 2 – PRODUCTS

2.1 ALUMINUM-FRAMED STOREFRONTS

A. Manufacturers: Provide one of the following or approved equal.

1. C.R. Laurence Company, Incorporated / U.S. Aluminum.

2. EFCO Corporation / Pella Company.

3. Kawneer North America.

B. Product Description: Kawneer’s “Trifab 451” is the Basis of the Specification.

1. Aluminum Frame: 2 inches by 4-1/2 inches deep, thermally broken; flush front glazing; capacity for 1/4 inch to 1 inch glazing infills,; drainage holes; internal weep drainage system.

2. Mullions: Profile of extruded aluminum with internal reinforcement of aluminum or shaped steel structural section where required to meet specified Performance Requirements.

3. Doors: Manufacturer’s heavy-duty aluminum framed glass doors; 1-3/4 to 1-7/8 inches thick, nominal 5 to 6 inch wide top rail and vertical stiles, ADA-compliant bottom rail; capacity for 1/4 inch to 1 inch infills, square glazing stops.

4. Frameless Glass Pivot Door: Basis of design CRL Wedge-Lock Dry Glazed Glass Securing system. 1/2" thick tempered glass with 14" high custom length 0" high alum. bottom and 4" high custom length square style non-clad door top rails and non-clad header. 10" high custom length square style non-clad door bottom rails with locks. Finish to be brushed stainless.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

C. Indoor Environmental Quality Characteristics:

1. Adhesives and Sealants: Maximum volatile organic compound content in accordance with Section 01 81 13.

2. Paints and Coatings: Maximum volatile organic compound content in accordance with Section 01 81 13.

2.3 COMPONENTS

A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper typical; 6061 alloy, T6 temper for extruded structural members.

B. Sheet Aluminum: ASTM B209, 5005 alloy, H15 or H34 temper.

C. Steel Sections: ASTM A36; shaped to suit mullion sections, galvanized or alkyd type zinc chromate primer complying with FS TT-P-645.

D. Glass: Specified in Section 08 80 00. Provide grey glazing sealants.

E. Glazing Materials: Storefront manufacturer's standard types to suit application and to achieve weather, moisture, and air infiltration requirements.

F. Gaskets: All gaskets to be grey.

H. Hardware: Specified in Section 08 71 00.

I. Sealant and Backing Materials:

1. Sealant Used Within System (Not Used for Glazing): Manufacturer's standard materials to achieve weather, moisture, and air infiltration requirements. Color to be grey.

2. Perimeter Sealant: Specified in Section 07 90 00.

J. Fasteners: Stainless, aluminum or other materials warranted by manufacturer to be non-corrosive and compatible with components being fastened.

K. Anchors: Stainless of size and type appropriate for intended use.

L. Shims: Multi-polymer plastic, 8000 psi, or stainless steel of same type used for anchors.

2.4 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal. Verify with Architect any restrictions upon the use of stacked shims at load bearing conditions.

B. Accurately fit and secure joints and corners. Make joints flush, hairline.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Arrange fasteners and attachments to conceal from view.

E. Reinforce interior horizontal head rail to receive window treatment brackets and attachments, where required.

F. Prepare components with internal reinforcement for door hardware.

G. Reinforce framing members for imposed loads.

2.5 ALUMINUM FINISHES

A. High-Performance Organic Finish – Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Color: Match Glazed Aluminum Curtainwall as specified in Section 08 44 13.

B. Concealed Steel Items: Galvanized to ASTM A123; primed with iron oxide paint.

C. Apply bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar metals.

D. Shop Primer for Steel Components: SSPC Paint 25 red oxide.

E. Touch-Up Primer for Galvanized Steel Surfaces: SSPC Paint 20 zinc rich.

F. Extent of Finish:

1. Apply finish to surfaces cut during fabrication where visible in completed assemblies, including joint edges.

2. Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division - Administrative Requirements: Coordination and project conditions.

B. Verify dimensions, tolerances, and method of attachment with other Work.

C. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

3.2 INSTALLATION

A. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

B. Provide alignment attachments and shims to permanently fasten system to building structure. Do not stack shims where they will bear gravity loads unless approved by Architect.

C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent Work as indicated.

D. Provide thermal isolation where components penetrate or disrupt building insulation.

E. Install sill flashings. Turn up ends and edges; seal to adjacent Work to form water tight dam.

F. Coordinate attachment and seal of perimeter air and vapor retarder materials.

G. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

H. Install integral flashings and integral joint sealers.

I. Set thresholds in bed of mastic or sealant and secure.

J. Install hardware using templates provided. Refer to Section 08 71 00 for installation requirements.

K. Install infill panels using method required to achieve performance criteria.

L. Coordinate installation of glass with Section 08 80 00; separate glass from metal surfaces.

M. Coordinate installation of perimeter sealants with Section 07 90 00.

3.3 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch every 3 feet non-cumulative or 1/16 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 FIELD QUALITY CONTROL

A. Test to AAMA 502 or 503. Perform test at three different locations identified by Architect or Owner's Representative. Test at earliest date possible subsequent to completion of storefront installation and curing of sealants. At locations of failed tests, correct deficiencies; inspect and correct for similar deficiencies found at other storefront locations. Re-test failed locations at no additional cost to Owner until all tests pass.

3.5 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.6 CLEANING

A. Division 1 - Execution and Closeout Requirements: Final cleaning.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

D. Remove excess sealant by method acceptable to sealant manufacturer.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Division 1 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect finished Work from damage.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes design and provision of tubular aluminum-framed glazed curtain wall systems with or without supplementary internal support framing, integral operable window units and louver units where shown on Drawings, glass glazing, metal infill panels, related flashings, integral and perimeter sealants, insulation at floor slab interface, anchorage and attachment devices.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 05 50 00 - Metal Fabrications: Steel fabricated attachment devices.
3. Section 07 42 43 – Composite Wall Panels: Infill panels in curtainwall.
4. Section 07 62 00 – Sheet Metal Flashing and Trim.
5. Section 07 90 00 - Joint Protection: System perimeter sealant and back-up materials.
6. Section 08 41 13 – Aluminum-Framed Storefronts and Entrances: Includes entrances installed into curtain wall.
7. Section 08 80 00 – Glazing: Glass glazing in curtainwall.

1.2 REFERENCES

A. Aluminum Association:

1. AA ADM 1 - Aluminum Design Manual.

B. American Architectural Manufacturers Association/Window & Door Manufacturers Association:

1. AAMA/WDMA 101/I.S.2 - Specification for Windows, Doors and Unit Skylights.
2. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Glass Doors.
3. AAMA 503 - Voluntary Specification for Field Testing of Metal Storefronts. Curtain Wall and Sloped Glazing Systems.
4. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
5. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
6. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

7. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
8. AAMA CW-DG-1 – Aluminum Curtain Wall Design Guide Manual.
9. AAMA MCWM-1 – Metal Curtain Wall Manual.
10. AAMA SFM-1 - Aluminum Store Front and Entrance Manual.

C. American Society of Civil Engineers:

1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
5. 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.
6. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
7. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
8. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential.
9. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.

E. California Code of Regulations, Title 24, Part 1:

1. CAC – California Administrative Code

F. National Fenestration Rating Council Incorporated:

1. NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

G. SSPC: The Society for Protective Coatings:

1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

2. SSPC Paint 25 - Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer.

1.3 PERFORMANCE REQUIREMENTS

A. System Design: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners.

1. As calculated in accordance with the current version of the California Building Code, as tested in accordance with ASTM E330. Refer to Structural Drawings.

2. Safety Factor: Unless otherwise specified, design components, parts, and assemblies including glazing stops, gaskets, adhesives, and sealants for a safety factor not less than 1.5. Failure of any part or assembly not acceptable at less than 1.5 times design wind load pressure. Failure defined as breakage, disengagement, permanent deformation of framing members in excess of L/1000 or 1/64-inch of their clear span, whichever is less; or permanent deformation of anchor assemblies beyond tolerance and slippage limitations.

3. Deflection Normal to Wall Plane: Limit mullion deflection to 1/175 for spans under 13'-6" or 3/4 inch, whichever is less, except L/360 at members adjacent to plaster or gypsum board surfaces; with full recovery of glazing materials.

B. System Assembly: Accommodate without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing, interstory drift.

C. Air Infiltration: Limit air leakage through assembly to 0.06 cfm/min/sq ft of wall area, measured at reference differential pressure across assembly of 6.24 psf as measured in accordance with AAMA/WDMA 101/I.S.2.

D. Water Leakage: None, when measured in accordance with AAMA/WDMA 101/I.S.2 with test pressure difference of 20 percent of design pressure, with minimum differential of 2.86 lbf/sq ft and maximum of 12.00 lbf/sq ft.

E. Air and Weather Seal: Maintain continuous air and weather barrier at all perimeter interfaces at adjacent assemblies.

F. Thermal and Solar Heat Transmittance of Assembly (U-Factor and Solar Heat Gain Coefficient): NFRC 100; comply with the California Energy Code for climate zone in which project is located.

G. Expansion / Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over 12 hour period without causing detrimental effect to system components and anchorage.

H. System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.

I. Not Permitted: Assemblies shall be free from rattles, vibration harmonics, wind whistles, noises caused by thermal and structural movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of the system.

J. Design Modifications: Maintain general design concept without altering profiles or adversely affecting appearance, durability, or strength of materials. Modifications acceptable only as may be necessary to comply with design criteria. Submit variations in details and materials for review.

1.4 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

1. Shop Drawings: Provide stamped engineered drawings indicating system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details. Furnish elevations of each section of storefront and include details of each condition for each storefront section, indicating anchorages, sealant application, glazing system, integration of flashings specified elsewhere, and as required for proper fabrication, assembly, and installation.

2. Calculations: Submit stamped engineered calculations to substantiate shop drawing compliance with the specified design criteria.

a. Design Data: Indicate framing member structural and physical characteristics, dimensional limitations.

B. Product Data: Submit component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.

C. Test Reports: Submit certified test reports showing compliance with specified Performance Requirements.

D. Samples: Submit 12 x 12 inches in size illustrating each type of finished aluminum surface, and glass glazing materials.

E. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.

a. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.

2. Indoor Air Quality Certificates: Certify volatile organic compound content for each interior adhesive and sealant and related primer.

F. Provide documentation showing paints and coatings in accordance with 01 81 13 Sustainable Design Requirements

1.5 QUALIFICATIONS

A. Manufacturer and Installer: Companies specializing in manufacturing and installing aluminum glazing systems with minimum five years' experience and with service facilities within 100 miles of Project.

1.6 PRE-INSTALLATION MEETINGS

A. Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner's representative, Architect, Contractor, and subcontractors whose work is relevant to this Specification Section.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Packing, Shipping, Handling, and Unloading: Deliver fabricated units and accessories to the project site in accordance with the requirements of AAMA CW-10, in manufacturer's original packaging, clearly identified with manufacturer's name and type of product, finish, and installation location.

B. Storage and Protection: Store in the original packaging, indoors, in an upright position, protected from damage. Handle in a manner to prevent twisting and other damage.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install sealants nor glazing materials when ambient temperature is less than 40 degrees F during and 48 hours after installation.

1.9 COORDINATION

A. Coordinate the Work with installation of metal flashings, air and weather barriers, automatic entrance doors, and door hardware components or materials.

1.10 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Product warranties and product bonds. Contractor shall make repairs and replacements upon notification of defects.

1. Assembly: Warrant for 10 years against excessive deflection, water penetration and failure of operable components.

2. Finishes: Warrant for 20 years against excessive deterioration of finishes.

PART 2 – PRODUCTS

2.1 GLAZED ALUMINUM CURTAIN WALL

A. Manufacturers: Provide one of the following or approved equal.

1. C.R. Laurence Company, Incorporated / U.S. Aluminum.
2. EFCO Corporation / Pella Company.
3. Kawneer North America.
4. Shuco USA L.P.
5. Overrgaard, Ltd.

B. Product Description: Overgaard Ltd 1034is the Basis of the Specification. Glazed aluminum curtainwall, thermally broken with interior tubular section insulated from exterior glass retaining member; matching stops and glass retaining member of sufficient size and strength to provide bite on glass and infill panels; drainage holes, deflector plates and internal flashings to accommodate internal weep drainage system.

1. Aluminum Frame: Profile of extruded aluminum with 2-3/4 inches by 7-1/2 inches, with minimum wall thickness of 1/8 inch, flush front glazing by pressure plate or combination pressure plate and structural silicone glazing; capacity for 1/4 inch to 1-11/16 inch glazing infills.
2. Reinforcement: Internal reinforcement of aluminum or shaped steel structural section where required to meet specified Performance Requirements.
3. Miscellaneous aluminum sill extensions, mullion closures and other profiles as shown on Drawings or required for a complete system.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

C. Indoor Environmental Quality Characteristics:

1. Adhesives and Sealants: Maximum volatile organic compound content in accordance with Section 01 81 13.
2. Paints and Coatings: Maximum volatile organic compound content in accordance with Section 01 81 13.

2.3 COMPONENTS

A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper typical; 6061 alloy, T6 temper for extruded structural members.

B. Sheet Aluminum: ASTM B209, 5005 alloy, H15, H16 or H34 temper.

C. Steel Sections: ASTM A36; shaped to suit mullion sections, galvanized or alkyd type zinc chromate primer complying with FS TT-P-645.

D. Glass: Specified in Section 08 80 00. Glazing sealants to be grey.

E. Glazing Materials: Curtainwall manufacturer's standard types to suit application and to achieve weather, moisture, and air infiltration requirements.

F. Gaskets: All gaskets to be grey.

G. Infill Panels:

1. Composite Panel: Specified in Section 07 42 43.

H. Flashings: Pre-Finished Aluminum Sheet as specified in Section 07 62 00 unless otherwise indicated on Drawings. Finish to match mullion sections where exposed.

I. Sealant and Backing Materials:

1. Sealant Used Within System (Not Used for Glazing): Manufacturer's standard materials to achieve weather, moisture, and air infiltration requirements.

2. Perimeter Sealant: Specified in Section 07 90 00.

J. Insulation: Mineral wool, specified in Section 07 21 16.

K. Fasteners: Stainless, aluminum or other materials warranted by manufacturer to be non-corrosive and compatible with components being fastened.

L. Anchors: Stainless of size and type appropriate for intended use.

M. Shims: Multi-polymer plastic, 8000 psi, up to 1/4 inch maximum thickness, or stainless steel of same type used for anchors.

2.4 FABRICATION

A. Do not begin fabrication until after approval of shop drawings and approval of any visual or testing mockups.

B. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal. Verify with Architect any restrictions upon the use of stacked shims at load bearing conditions.

C. Accurately machine and fit joints, corners, copes and miters, and rigidly fasten together tat contact points by welding or approved mechanical connections in accordance with approved shop drawings. Secure joints and corners. Make joints flush and hairline unless otherwise shown. Do not rigidly fasten joints designed to accommodate movement.

D. Prepare components to receive anchor devices. Fabricate anchors and paint all ferrous metal parts to be concealed with zinc rich primer.

E. Reinforce framing members and joints with steel plates, bars, rods, or angles for rigidity and strength as needed to fulfill Performance Requirements. Use concealed stainless steel fasteners for jointing which cannot be welded.

F. Provide fasteners of strength sufficient to support both horizontal wind load and vertical dead load. Space and size fasteners to develop the maximum strength of the members they secure or support. Arrange fasteners and attachments to conceal from view.

G. Make provisions in doors and frames to receive the specified hardware and accessories. Where concealed closers or other mechanisms are required, provide the necessary space, cutouts, and reinforcements for secure fastening.

H. Do not label exposed portions with trade or manufacturer's name.

2.5 ALUMINUM FINISHES

A. Superior-Performance Organic Finish – Three-Coat PVDF: Fluoropolymer finish for extrusions complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Color: PPG Industries' Duranar XL ~~#UC82080XL "Champagne"~~ **#3ZMA3190 – "Ultra-Cool Champagne"**. Provide manufacturer's same color in coil-coat version as required for products specified in other Sections to match Curtain Wall.

B. Extent of Finish:

1. Apply finish to surfaces cut during fabrication where visible in completed assemblies, including joint edges.

2. Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division - Administrative Requirements: Coordination and project conditions.

B. Verify dimensions, tolerances, and method of attachment with other Work.

C. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

3.2 INSTALLATION

A. Install wall system in accordance with AAMA MCWM-1.

B. Coordinate glazed aluminum curtain wall systems with the work of other trades and provide items placed during the installation of other work at the proper time to avoid delays in the work. Place such items, including inserts and anchors, accurately in relation to the final location of curtain wall components.

C. Attach aluminum curtain wall system to structure with steel plates and profiles to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

D. Provide alignment attachments and shims to permanently fasten system to building structure. Do not stack shims where they will bear gravity loads unless approved by Façade SEOR

E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent Work as indicated.

F. Provide thermal isolation where components penetrate or disrupt building insulation.

G. Install sill flashings. Set into two, continuous, parallel rows of sealant at concrete. Turn sill flashings up 1/2 inch or as indicated on Drawings at ends and edges; seal to adjacent Work to form water tight dam.

H. Coordinate attachment and seal of perimeter air and vapor retarder materials.

I. Install integral flashings and integral joint sealers.

J. Install infill panels using method required to achieve performance criteria.

K. Coordinate installation of glass with Section 08 80 00; separate glass from metal surfaces.

L. Coordinate installation of perimeter sealants with Section 07 90 00.

3.3 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch every 3 feet non-cumulative or 0.5 inch per 100 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: ½" Nominal.

3.4 FIELD QUALITY CONTROL

A. Test installation for water penetration per AAMA 502 or 503. Perform test at 1 different location identified by Architect or Owner's Representative. Test at earliest date

possible subsequent to completion of curtain wall installation and curing of sealants. At locations of failed tests, correct deficiencies; inspect and correct for similar deficiencies found at other curtain wall locations. Re-test failed locations at no additional cost to Owner until all tests pass.

B. Curtain wall manufacturer to provide field surveillance of installation of system.

3.5 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.6 CLEANING

A. Division 1 - Execution and Closeout Requirements: Final cleaning.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

D. Remove excess sealant by method acceptable to sealant manufacturer.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Division 1 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect finished Work from damage.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions of Division 1 Specification Sections, apply to this Section.

1.2 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.

1.3 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

1.4 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	6A A	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.

1.5 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.

1.6 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.

1.7 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.

1.8 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.

1.9 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

2.1 MANUFACTURERS

Item	Manufacturer	Acceptable Substitutes
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 ¾” 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 ¼” 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.

2.2 KEYING

A. Furnish a Proprietary Schlage masterkey system as directed by the owner or architect. Key system to be designated and combinated 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.

2.3 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.

2.4 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

3.1 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.

3.2 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.

3.3 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.

3.4 HARDWARE LOCATIONS

A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.5 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.

3.6 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.)

BLU	=	Blumcraft	Frameless Glass Door Panic Hardware
DRM	=	Dorma	Frameless Glass Door Closer
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
SCH	=	Schlage Lock Company	Locks, Latches & Cylinders
VON	=	Von Duprin	Exit Devices
ZER	=	Zero International	Thresholds, Gasketing & Weather-stripping

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GROUP NO. 01

1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-99-L-NL-06	626	VON
1	EA	SFIC RIM CYLINDER	80-159	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	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		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 02

1	EA	CONT. HINGE	224XY TWP	628	IVE
1	EA	VANDL EU STOREROOM	ND80HDEU 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	DOOR STOP	FS439 OR WS401/402CVX	682	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	153A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 03

1	EA	CONT. HINGE	224XY TWP	628	IVE
1	EA	VANDL EU STOREROOM	ND80HDEU RHO RX 12V/24V DC	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	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		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 04

2	EA	HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	EA	ELECTRIC HINGE	5BB1HW 5 X 4.5 TW8	630	IVE
1	EA	EU MORTISE LOCK	L9095HDEU 06A CON 12/24 VDC	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	153A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 05

1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-99-L-M996-06-FSE	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	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		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 06

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630	689	LCN
1	SET	SEAL SET	WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 07

2	EA	CONT. HINGE	224XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-AX-PA-3349A-EO-LBL 24 VDC	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-3349A-NL-OP-LBL-388 24 VDC	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
2	EA	LONG DOOR PULL	9264 36" 20" O	630-316	IVE
2	EA	OH STOP	100S	630	GLY
1	EA	SURF. AUTO OPERATOR	9553 REG2 MS AS REQ (120/240 VAC)	ANCLR	LCN
2	EA	ACTUATOR	INGRESS'R I36-3	630	WIK
2	EA	BOLLARD	SQ SERIES 6"X 6" PREPPED FOR INGRESS'R	630	WIK
1	SET	SEAL SET	WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		
1	EA	POWER SUPPLY	PS906 900-2RS 120/240 VAC	LGR	SCE
			CARD READER - WORK OF DIVISION 28		

GROUP NO. 08

2	EA	CONT. HINGE	224XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
2	EA	ELEC PANIC HARDWARE	RX-PA-3349A-L-BE-E360-06-FS-WH 24 VDC	628	VON
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP ST-1630	689	LCN
1	SET	SEAL SET	WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		
1	EA	THRESHOLD	PER DETAIL		ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 09

2	EA	CONT. HINGE	700	630	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	STOREROOM/CLOSET LOCK	CL3357 PZD, CYLINDER PER PG&E	626	C-R
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
2	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 10

1	EA	CONT. HINGE	700	630	IVE
1	EA	CONT. HINGE	700 EPT	630	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	MANUAL FLUSH BOLT	FB458 12"	626	IVE
1	EA	MANUAL FLUSH BOLT	FB458 24"	626	IVE
1	EA	VANDL EU STOREROOM	ND80HDEU RHO RX 12V/24V DC	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
2	EA	OH STOP & HOLDER	100H	630	GLY
1	EA	ASTRAGAL	43SP	SP	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 11

1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-33A-L-BE-E360-06-299-FS-WH 24 VDC	628	VON
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	SET	SEAL SET	WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		
1	EA	THRESHOLD	PER DETAIL		ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 12

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL OFFICE LOCK	ND91HD 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	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94HD 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. 14

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94HD 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. 15

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94HD 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
3	EA	SILENCER	SR64	GRY	IVE

GROUP NO. 16

3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94HD 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 PSA	BK	ZER

GROUP NO. 17

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	ND80HDEU 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 OR BY FRAME MFR	BK	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 18

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	VANDL EU STOREROOM	ND80HDEU 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	DOOR STOP	FS439 OR WS401/402CVX	682	IVE
1	EA	GASKETING	188SBK OR BY FRAME MFR	BK	ZER
1	EA	DOOR BOTTOM	364AA	AA	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 19

2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	652	IVE
1	EA	VANDL EU STOREROOM	ND80HDEU 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	DOOR STOP	FS439 OR WS401/402CVX	682	IVE
1	EA	GASKETING	188SBK OR BY FRAME MFR	BK	ZER
1	EA	DOOR BOTTOM	364AA	AA	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 20

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	EU MORTISE LOCK	L9492HDEU 06A L583-363 RX DM CON 12/24 VDC	626	SCH
1	EA	OUTSIDE INDICATOR	L283-414 (OCCUPIED/VACANT) (PROVIDED BY GOOGLE)	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		
			POWER SUPPLY - WORK OF DIVISION 28		

TURNING INSIDE THUMBTURN TO SHUNT POWER TO CARD READER

GROUP NO. 21

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	VANDL EU STOREROOM	ND80HDEU RHO RX 12V/24V DC	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630	689	LCN
1	EA	GASKETING	188SBK OR BY FRAME MFR	BK	ZER
1	EA	DOOR BOTTOM	364AA	AA	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

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	ELEC FIRE EXIT HARDWARE	RX-PA-AX-99-L-F-M996-06-FSE	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 23

1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-99-L-M996-06-FSE	626	VON
1	EA	SFIC RIM CYLINDER	80-159	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	DOOR STOP	FS439 OR WS401/402CVX	682	IVE
1	EA	GASKETING	188SBK OR BY FRAME MFR	BK	ZER
1	EA	DOOR BOTTOM	364AA	AA	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 24

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-99-L-M996-06-FSE	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	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	EA	DOOR STOP	FS439 OR WS401/402CVX	682	IVE
1	EA	GASKETING	188SBK OR BY FRAME MFR	BK	ZER
1	EA	DOOR BOTTOM	364AA	AA	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 25

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-99-L-M996-06-FSE	626	VON
1	EA	SFIC RIM CYLINDER	80-159	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	DOOR STOP	FS439 OR WS401/402CVX	682	IVE
1	EA	GASKETING	188SBK OR BY FRAME MFR	BK	ZER
1	EA	DOOR BOTTOM	364AA	AA	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 26

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96HD 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
3	EA	SILENCER	SR64	GRY	IVE

GROUP NO. 27

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96HD 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. 28

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	ND40S RHO	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. 29

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 30

5	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 TW8	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	VANDL EU STOREROOM	ND80HDEU RHO RX 12V/24V DC	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
2	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	ASTRAGAL	44STST OR BY HM DOOR MFR	STST	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 31

5	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 TW8	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	VANDL EU STOREROOM	ND80HDEU RHO RX 12V/24V DC	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	ASTRAGAL	44STST OR BY HM DOOR MFR	STST	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 32

8	EA	POCKET PIVOT	91105F	630	IVE
2	EA	FIRE EXIT HARDWARE	AX-9447-L-BE-F-06	626	VON
2	EA	SURFACE CLOSER	4000T	689	LCN
2	EA	MAGNET	SEM7840 12V/24V/120V	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	SET	MEETING STILE	328AA-S	AA	ZER
2	EA	DOOR SWEEP	8192AA	AA	ZER

MAG HOLDER TIED TO FIRE ALARM

GROUP NO. 33

2	EA	BOTTOM PIVOT	7215 BTM	626	IVE
2	SET	OVERHEAD CONC. CLOSER	RTS88	689	DRM
2	EA	EXIT DEVICE	PA-100-F W/ KEY LOCK	626	BLU
2	EA	SFIC MORTISE CYL.	80-131	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
2	SET	TOP AND BOTTOM RAILS/PATCH FITTINGS	BY FRAMELESS GLASS DOOR MANUFACTURER		

GROUP NO. 34

1	EA	CYLINDER	80-XXX EV B TYPE AS REQUIRED BY DOOR MFR BALANCE OF HARDWARE BY ROLL UP DOOR MFR	626	SCH

GROUP NO. 35

HARDWARE BY DOOR MANUFACTURER

GROUP NO. 36

4	EA	POCKET PIVOT	91105F	630	IVE
2	EA	FIRE EXIT HARDWARE	AX-9447-EO-F	626	VON
2	EA	SURFACE CLOSER	4000T	689	LCN
2	EA	MAGNET	SEM7840 12V/24V/120V	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	ASTRAGAL	47A	A	ZER

MAG HOLDER TIED TO FIRE ALARM

GROUP NO. 37

6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	ASTRAGAL	44STST OR BY HM DOOR MFR	STST	ZER

GROUP NO. 38

8	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	MANUAL FLUSH BOLT	FB458 24"	626	IVE
1	EA	VANDL CLASSROOM LOCK	ND94HD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
2	EA	OH STOP	90S	630	GLY
2	EA	WALL STOP	WS401/402CCV	626	IVE
2	EA	SILENCER	SR64	GRY	IVE

GROUP NO. 39

5	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 TW8	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	VANDL EU STOREROOM	ND80HDEU RHO 12V/24V DC	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	ASTRAGAL	44STST OR BY HM DOOR MFR	STST	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 40

1	SET	BARN DOOR TRACK AND HARDWARE	200WF	AL	JOH
1	EA	BARN DOOR STRIKE	2001BSTK	626	ACC
1	EA	LEVER TRIM	L9070L 06A LLL LLL LESS LOCK CASE	626	SCH
1	EA	CLASSROOM LOCK CASE	SL9145ADA	626	ACC
1	EA	SFIC MORTISE CYL.	80-131	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH

GROUP NO. 41

1	EA	CYLINDER	80-XXX EV B TYPE AS REQUIRED BY DOOR MFR	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B HARDWARE BY FOLDING DOOR MFR	626	SCH

GROUP NO. 42

6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-9949-L-M996-06-FSE-LBL	626	VON
1	EA	SFIC MORTISE CYL.	80-131	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	SURFACE CLOSER	4040XP EDA ST-1956 TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	ASTRAGAL	44STST OR BY HM DOOR MFR	STST	ZER
			CARD READER - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 43

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	PA-AX-98-EO	626	VON
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR BOTTOM	355AA	AA	ZER

GROUP NO. 44

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL OFFICE LOCK	ND91HD 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
1	EA	DOOR BOTTOM	364AA	AA	ZER

END OF SECTION

PART 1- GENERAL

1.1 SUMMARY

This section includes the following types of automatic door operators:

1. In-ground, low energy door operators for swinging doors.

Related Sections:

2. Division 7 Sections for caulking to the extent not specified in this section.
3. Division 8 Section “Aluminum-Framed Entrances and Storefronts” for entrances furnished separately in Division 8 Section.
4. Division 8 Section “Sliding Automatic Entrances” for single and bi-parting sliding automatic entrance doors with sidelites.
5. Division 8 Section “Door Hardware” for hardware to the extent not specified in this Section.
6. Division 26 and 28 Sections for electrical connections including conduit, liquid-tight connections, and wiring for automatic entrance door operators and access control devices.

1.2 REFERENCES

References: Refer to the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.

American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA).

7. ANSI/BHMA A156.10 American National Standard for Power Operated Pedestrian Doors.
8. ANSI/BHMA A156.19 Standards for Power Assist and Low Energy Power Operated Doors.

American Association of Automatic Door Manufacturers (AAADM).

American Society for Testing and Materials (ASTM).

9. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

10. ASTM B209 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

American Architectural Manufacturers Association (AAMA).

11. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.

National Association of Architectural Metal Manufacturers (NAAMM).

12. Metal Finishes Manual for Architectural Metal Products.

International Code Council (ICC).

13. CBC: California Building Code.

1.3 DEFINITIONS

Activation Device: Device that, when actuated, sends an electrical signal to the door operator to activate the operation of the door.

1. Knowing act: Consciously initiating the opening of a power operated door using acceptable methods including wall mounted switches such as push plates and controlled access devices such as keypads, card readers and key switches.

Safety Device: A device that detects the presence of an object or person within a zone where contact could occur and provides a signal to stop the movement of the door.

Double Egress Doors: A pair of doors that swing with the two doors moving in opposite directions and no mullion between them.

1.4 PERFORMANCE REQUIREMENTS

Automatic door equipment accommodates medium to heavy pedestrian traffic.

Opening Force Requirements: Doors shall open with a manual force, not to exceed 30lbf (133N) to set the door in motion and 15 lbf to fully open the door applied at 1” (25 mm) from the latch edge of the door. The force required to prevent a stopped door from opening or closing shall not exceed 15 lbf (67 N) measured 1” (25 mm) from the latch edge of the door at any point during opening or closing.

Closing Time:

1. Doors shall be field adjustable to close from 90 degrees to 10 degrees in 3 seconds or longer as applicable per ANSI/BHMA A156.19 standards.

2. Doors shall be field adjusted to close from 10 degrees to fully closed in not less than 1.5 seconds.

1.5 SUBMITTALS

Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, fabrication, operational descriptions and finishes.

Shop Drawings: Submit manufacturer’s shop drawings, including elevations, sections and details, indicating dimensions, materials, operator, motion /presence sensor control device, anchors, hardware, finish, options and accessories.

1. Indicate required clearances, and location and size of each field connection.

2. Indicate locations and elevations of entrances showing activation devices.

3. Wiring Diagrams: For power, signal, and activation / safety device wiring.

Samples: Submit manufacturer’s samples of aluminum finish.

Manufacturers Field Reports: Submit manufacturer’s field reports from AAADM certified technician of inspection and approval of doors for compliance with ANSI/BHMA after completion of installation.

Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the work of this section in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the operators and their nearest service representatives. The final copies delivered after completion of the installation test to include spare parts list.

Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.6 QUALITY ASSURANCE

Manufacturers Qualifications: Engage qualified manufacturers with a minimum 10 years of documented experience in manufacturing of doors and equipment of similar to that indicated for this Project and that have a proven record of successful in-service performance. Manufacturer to have a company certificate issued by AAADM.

Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing and maintenance of units similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

Certified Inspector Qualifications: Certified by AAADM.

Source Limitations for Automatic Door Operators: Obtain each type of door, frame, operator and sensor components specified in this Section from a single source, same manufacturer unless otherwise indicated.

1. Operator shall be furnished complete with the cement case, case cover and drive mechanism from a single manufacturer.

Certifications: Operators shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards.

2. ANSI/BHMA A156.19 American National Standard for Power Assist and Low Energy Operated Doors.

3. NFPA 101 - Life Safety Code.

Emergency Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrance doors serving as a required means of egress.

1.7 COORDINATION

Coordinate door operators with doors, frames and related work to ensure proper size, thickness, hand, function and finish. Coordinate hardware for automatic entrances with hardware required for rest of the project.

Coordinate sizes and locations of recesses in concrete if applicable. Concrete, reinforcement and formwork are specified in Division 03.

Electrical System Roughing-in: Coordinate layout and installation of power door operators with connections to power supplies and access control system as applicable.

1.8 WARRANTY

General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

Automatic Door Operators shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.

During the warranty period a factory-trained technician shall perform service and affect repairs. An inspection shall be performed after each adjustment or repair.

During the warranty period all warranty work, including but not limited to emergency service, shall be performed during normal business hours.

Manufacturer shall have in place a dispatch procedure that shall be available 24 hours a Day, 7 Days a week for emergency call back service.

PART 2- PRODUCTS

2.1 MANUFACTURER

Basis of Design Manufacturer: ASSA ABLOY Entrance Systems, 1900 Airport Road, Monroe, NC 28110. Toll Free (877) SPEC-123. Fax (704) 290- 5555 Website www.assaabloyentrance.com contact: specdesk.na.aaes@assaabloy.com

Acceptable Manufacturers: Subject to compliance with the requirements, provide products by one of the following:

1. ASSA ABLOY Entrance Systems, Inc.; an ASSA ABLOY Group Company.
2. Horton Automatics; a Division of Overhead Door Corporation.
3. Stanley Access Technologies; Division of The Stanley Works.

2.2 MATERIALS

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, as indicated below:
2. Extruded Aluminum, Alloy 6063-T5.

2.3 SWING DOOR OPERATORS

Model: LCN 9553

Reference Standard: ANSI/BHMA A156.19.

1. Configuration: Operator to control pairs of swinging doors as indicated on the drawings and specified below:
   a. Traffic Pattern: Two way.
   b. Pairs of Doors: Simultaneous swing.
2. Automatic Door Operator: Electro-mechanical, non-handed operator, powered by 24 volt, 1/4 hp motor. Operator shall be adjustable to compensate for different manual push forces as required.
   a. Automatic operator shall be capable of operating and controlling up to a 700 pound (317.5 kg) door, 48 inches (1219 mm) in width.
   b. In-Ground Operator Enclosure and Drive Unit:
      i. Cement case shall be 12 gauge minimum thickness steel, fully welded enclosure.
         i) Corrosion Protection: 6 to 10 mill powder coat finish suitable for continuous protection when in contact with concrete and masonry.
      ii. Removable top case cover shall be 12 gauge minimum thickness steel with powder coat finish.
         i) Cover shall be sealed to cement case by a neoprene gasket.

ii) All penetrations including the operator drive shaft shall have seals to prevent water and moisture infiltration.

iii. Drive Mechanism Assembly: Manufacturer's drive mechanism assembly designed to provide swing door operation from an in-ground automatic door operator.

i) Operator shaft shall be directly coupled to the pivot assembly.

ii) Weight of door shall be fully supported independently through a pivot bearing support. Door weight shall not be supported by the operator or the gear box assembly.

iv. Connecting hardware to door shall be a door arm attached to the bottom rail of the swing door.

i) Output shaft adapter and door arm shall allow for center pivoted installation as indicated on drawings.

ii) Top pivot assembly shall be supplied by Division 8 Section "Door Hardware".

c. Operator Temperature Range: Capable of operating within temperature ranges of -31° F to 160° F (-35° C to 71° C).

d. Electrical Characteristics: Maximum power consumption is 300 watts (2.5 amps at 120 VAC), 50/60hz, built-in thermal overload protection.

3. Door Operation:

a. Opening Cycle The adjustable speed operator mechanically powers the drive shaft and the torque control maintains constant speed throughout the opening cycle regardless of stack pressures or wind speed. Operator shall allow manual door operation with operational forces as indicated to fully open the door applied at 1" (25 mm) from the latch edge of the door.

i. Manual push force shall be adjustable from 5 lbf to 15 lbf maximum.

b. Hold Open: The operator shall stop and hold the door open at the selected door opening angle for an adjustable period of time (1.5 seconds to 30 seconds).

c. Closing Cycle: Spring close with speed controlled power assist.

i. Upon loss of power, dynamic braking will control the door insuring controlled closing.

ii. Selectable Torque Control: Automatically adjusts torque without changing the closing speed of the operator.

i) When the torque control is activated, the closing speed shall remain constant regardless of stack pressures or wind speed.

ii) Torque Cancellation: The torque control is deactivated whenever there is a signal received from door mounted sensors.

iii) The torque control is disabled during manual use of the door.

d. Wind Force Dampening: The operator electromechanically counteracts wind forces, slowing down the door movement to safely open or close the door.

e. Stack Pressure Compensation: Operator shall counteract positive stack pressures, negative stack pressures, and sudden changes of stack pressures. The operator never allows the door to open or close faster than the speed control settings, regardless of pressures.

f. Obstruction Control: The operator will stop and reverse the door movement.

g. Electric Lock Management:

i. Internal module for electrified locking integration.

ii. Electric Lock Output: Selectable 12 VDC, maximum 1200 mA / 24 VDC, maximum 600 mA.

iii. Lock monitoring prevents operator(s) from opening door(s) until release of electrified lock.

iv. Operator pulls door closed before opening, automatically unjamming electric latch hardware.

v. Sequenced operation between operators for pairs of doors allowing lock release and astragal coordination.

h. Lock Retry Circuit: If attempt to fully close the door is unsuccessful, the operator will automatically reverse open 10 degrees and reclose in an attempt to successfully close the door.

i. Selectable Alarm Reset: The operator can be field set so that after receiving an alarm signal, the operator will not accept any activation impulses and will operate only as a manual door closer until manually reset.

j. Electronic Controls: Solid state integrated circuit controls the operation and switching of the swing power operator. The electronic control provides low voltage power supply for all means of actuation. The controls include time delay (1 to 30 seconds) for normal cycle.

k. Control Switch: Automatic door operators shall be equipped with the following type of multi-position function switch:

i. 4 position rotary switch remotely mounted (On-Off-Hold- Special Function).

4. Operator Interface:

a. Safety Sensor Integration for overhead presence safety device and door mounted reactivation safety sensors.

2.4 ACTIVATION DEVICES

General: Provide activation and safety devices in accordance with ANSI/BHMA standards, for condition of exposure and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

Knowing Act Activation Device:

1. Touch-Activated Vertical Activation Column Door Control “INGRESS’R” as manufactured by Wikk Industries, Inc. Bollard mounted on Wikk Model B-6SQ-RT-32D-SM-INGR.
    b. Vertical activation column with activation of automatic door from any approach and height level along vertical profile.
        i. Size: 36” high x 2-1/2” wide 136 Series activation column mounted in a 36” high x 6” wide x 1-1/2” deep enclosure.
        ii. Engraved with "Push to Open" and a I.S.A. logo.
    c. Tapered profile deflects impact from wheeled conveyances and directs movement into center vertical activation column.
    d. Vandal and Weather Resistant.
    e. Stainless Steel: Type 304, nominal thickness 18/19 gauge sheet metal.
        i. Stainless Steel Finish: Satin US32D. Blue wheelchair I.S.A. logo.
    f. Hard Wire: Hard-wired from flush junction boxes.

Manual Operation:

2. Operator shall allow manual door operation with operational forces adjustable from 5 lbf to 15 lbf maximum.

3. Floor plate: Floor Plate/Threshold: Manufacturer’s standard threshold as indicated. 1/2 inch high CBC and ADA compliant aluminum threshold extending the width of the door opening.

PART 3- EXECUTION

3.1 EXAMINATION

1. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance of swinging power operated doors.

2. Examine roughing-in for electrical source power to verify actual locations of wiring connections.

3. Verify that all electrical penetrations into the cement case enclosure have liquid tight fittings.
    1. Water-test electrical conduit penetrations (high volt and low volt connections) in cement case to assure leak-free system.

Proceed only after such discrepancies or conflicts have been resolved.

3.2 INSTALLATION

Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.

Operators: Install automatic door operators plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install in-ground operator housing in accordance with manufacturer's instructions and reviewed shop drawings.
2. Install operator drive mechanism assembly in accordance with manufacturer's instructions.
3. Adjust operator and drive mechanism to achieve smooth operation including back-check, latch, and proper limit stops.
4. Install exposed to view fittings using concealed fasteners where possible.
5. Install threshold and operator fittings per manufacturer's instructions.

Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

Sealants: Comply with requirements specified in division 7 Section "Joint Sealants" to seal between the operator housing and the adjacent surfaces and provide a water-tight closure.

Signage: Apply signage on both sides of each door and sidelite as required by ANSI/BHMA A156.19 and manufacturers installation instructions.

3.3 ADJUSTING

Adjust automatic door operators, controls and hardware for smooth and safe operation and for weather tight closure. Adjust doors in compliance with ANSI/BHMA A156.19.

3.4 FIELD QUALITY CONTROL

Before placing doors into operation, AAADM certified technician shall inspect and approve doors for compliance with ANSI/BHMA A156.19. Certified technician shall be approved by manufacturer.

3.5 CLEANING AND PROTECTION

Clean adjacent surfaces soiled by automatic door operator installation.

Clean metal surfaces promptly after installation. Remove excess sealants, compounds, dirt and other substances. Repair damages and finish to match original finish.

3.6 DEMONSTRATION

Engage a factory-authorized representative to train Owner's maintenance personnel to adjust, operate, and maintain safe operation of the door.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes glass glazing for metal frames, doors, windows, glazed walls and other products referencing this Section.

B. Related Sections:

1. Section 07 90 00 – Joint Protection: Joint sealants.
2. Section 08 12 14 – Standard Steel Frames.
3 Section 08 14 16 – Flush Wood Doors.
4. Section 08 41 13 – Interior Entrances and Storefronts
5. Section 08 44 13 – Glazed Aluminum Curtain Walls.
~~6. Section 13 49 00 – Radiation Protection: Leaded glass.~~

1.2 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI Z97.1 - Standard For Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

B. American Society for Testing and Materials (ASTM)

1. ASTM C509 - Elastomeric Cellular Preformed Gasket and Sealing Compound.
2. ASTM C864 - Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
3. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
4. ASTM C1036 – Standard Specification for Flat Glass.
5. ASTM C1048 – Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
6. ASTM C1193 – Standard Guide for Joint Sealants.
7. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
8. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
9. ASTM E1300 – Standard Practice for Determining Load Resistance of Glass in Buildings.
10. ASTM E2190 – Standard Specification for Insulating Glass Unit Performance and Evaluation.

3. California Code of Regulations, Title 24, Part 2 (CCR):
    a. CBC – California Building Code.

C. Consumer Product Safety Commission (CPSC)

1. Safety Glazing Standard: CPSC 16 CFR Part 1201 for category I and II materials.

D. Glass Association of North America (GANA)

1. GANA - Sealant Manual.
2. GANA – Glazing Manual.
3. GANA – Laminated Glass Design Guide.

E. National Fire Protection Association (NFPA)

1. NFPA 80 – Standard for Fire Doors, Fire Windows.
2. NFPA 257 – Standard of Fire Test for Window and Glass Block Assemblies.

F. Underwriters Laboratories Inc. (UL)

1. UL 9 – Standard for Fire Tests of Window Assemblies.
2. UL 10C – Positive Pressure Fire Tests of Door Assemblies.
3. UL 263 – Fire Tests of Building Construction and Materials.

1.3 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Glass thicknesses and heat treatment, if specified, are minimum requirements. Engineer and provide glass thicknesses and heat treatment to comply with ASTM E1300.
2. Vertical Glass: Limit the statistical probability of failure to eight lites per thousand at Design Wind Pressures.
3. Glass Deflection - Vertical Lites, Interior or Exterior: Maximum center deflection no greater than 1 inch at center point at Design Wind Pressures.

B. Labeling: Each piece of tempered glass shall be permanently labeled with logo indicating glass type.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s literature and installation instructions for each material and accessory, clearly notating each specified requirement.

B. Samples: Each type and thickness of glass products, except for clear, 12 inches square.

C. Quality Assurance/Quality Control Submittals

1. Test Reports: Submit test reports, indicating the following products comply with specified requirements: insulated glass, coated float glass, heat soak testing for tempered glass, glazing sealants, glazing gaskets.

D. Closeout Submittals: Submit for Owner's documentation.

1. Warranties.

2. Maintenance Data.

1.5 QUALITY ASSURANCE

A. Qualified Installer: Installer to have five years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of authority having jurisdiction.

C. Perform Work in accordance with GANA Glazing Manual, GANA Sealant Manual, and GANA Laminated Glass Design Guide for glazing installation methods.

D. Fire Rated Window Glazing: Rating as indicated on Drawings. Tested in accordance with NFPA 257 and complying with NFPA 80.

1. NFPA 257: Adjusted so two-thirds of test specimen is above neutral pressure plane at 10 minutes into test.

E. Fire Rated Door Glazing: Tested in accordance with UL 10C and complying with NFPA 80.

F. Apply permanent testing agency label to identify each fire rated glass lite.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver products in manufacturer's unopened containers fully identified. Protect from scratches and abrasions. Clearly label each lite with manufacturer's name and brand. Keep handling to minimum.

1.7 WARRANTY

A. Division 1 – Execution and Closeout Requirements: Product warranties and bonds.

B. Furnish five year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

C. Furnish five year warranty to include coverage for delamination of laminated glass and replacement of same.

D. Furnish five year warranty to include coverage for deterioration of spandrel glass coating and replacement of same.

PART 2 − PRODUCTS

2.1 FLOAT GLASS MATERIALS

A. Annealed Glass: ASTM C1036, Type 1 transparent flat, Quality Q3, float glass.

B. Heat Strengthened Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind HS heat strengthened, Condition A uncoated, float glass.

C. Tempered Glass: ASTM C1036, Type 1 transparent flat, Quality Q3, Kind FT fully tempered, Condition A uncoated, float glass with horizontal tempering.

2.2 FLOAT GLASS PRODUCTS

A. Float Glass Manufacturers: Provide compliant fabricated glass products of one of the following or approved equal.

1. AGC Interpane Flat Glass North America, Inc.
2. Guardian Industries Corporation.
3. Pilkington North America, Inc.
4. Vitro Architectural Glass.

B. Laminated Glass Manufacturers: Provide compliant fabricated glass products of one of the following or approved equal:

1. GlassFab Tempering Services
   1448 Mariani Court
   Tracy, CA 95376
   PHONE (209) 229-1060
2. Old Castle
3. Saflex/Eastman Chemical Co.

C. Glazing Type (GL-01) - Insulating Glass Units: STC 44. ASTM E2190 certified by Insulating Glass Certification Council; edge-sealed. Purge interpane space with dry hermetic air. AGC Interpane is the basis of the specification.

1. Total Unit Thickness: 1 11/16”
2. Outboard lite: 6 mm clear glass heat strengthened (HS) with Ipasol Platin 47/27 on #2
3. 24 mm airspace. Grey T spacer with grey PIB (Argon fill)
4. Mid lite: 6 mm thick clear glass heat strengthened (HS)
5. Air space: 1.52 mm acoustic interlayer

6. Inboard lite: 6 mm thick clear glass heat strengthened (HS)

D. Glazing Type (GL-02) – 1 11/16" thick Insulated Glass Units: STC 44. ASTM E2190 certified by Insulating Glass Certification Council; edge-sealed. Purge interpane space with dry hermetic air. AGC Interpane is the basis of the specification.

1. Total Unit Thickness: 1 11/16"
2. Outboard lite: 6 mm clear glass heat strengthened (HS) with Ipasol Platin 47/27 on #2
3. 24 mm airspace. Grey T spacer with grey PIB (Argon fill)
4. Mid lite: 6 mm thick clear glass heat strengthened (HS)
5. Interlayer space: 1.52 mm acoustic interlayer
6. Inboard lite: 6 mm thick clear glass heat strengthened (HS) with RAL 9010 Silkscreen frit 2mm (on the portion of the lite), 80% coverage on #5

E. Glazing Type (GL-03) – 7/8" thick Laminated glass.

1. Total Unit Thickness: 7/8"
2. Outer pane: 10mm thick clear glass heat strengthened (HS)
3. Interlayer space: 1.52mm clear PVB
4. Inboard lite: 10mm thick clear glass heat strengthened (HS)

F. Glazing Type (GL-04): TBD

G. Glazing Type (GL-05) – 1" thick insulated glass

1. Outboard lite: 6 mm thick clear glass heat strengthened HS) with Ipasol Platin 47/27 on #2
2. Air space: 13mm grey spacer with grey PIB (Argon fill)
3. Inboard lite: 6mm thick clear glass heat strengthened (HS)

H. Glazing Type (GL-06) – Not Used.

I. Glazing Type (GL-07) Clear Laminated Glass, STC 40: Tempered float glass as specified, Class 1 clear. CPSC 16 CFR 1201 Category I and II safety.

1. Total Unit Thickness: 9/16".
2. Outer pane: 1/4" thick clear glass – tempered.
3. Interlayer space: .060 Acoustic Interlayer – SAFLEX QS71
4. Inboard lite: 1/4" thick clear glass – tempered.

J. Glazing Type (GL-08) Clear monolithic glass. Tempered float glass as specified, Class 1 clear. CPSC 16 CFR Category I and II safety.

1. Minimum thickness ½" inch.

K. Glazing Type (GL-09) – 1" thick insulated glass, STC 35. Tempered float glass as specified, Class 1 clear. CPSC 16 CFR 1201 Category I and II safety.

1. Outboard lite: 6 mm thick clear glass – tempered.

2. Air space: 13mm grey spacer with grey PIB (air fill)

3. Inboard lite: 6mm thick clear glass – tempered.

L. Glazing Type (GL-10) Clear Laminated Glass: Tempered float glass as specified, Class 1 clear. CPSC 16 CFR 1201 Category I and II safety.

1. Outboard lite: 3/16" thick clear glass – tempered.

2. Interlayer space: .030 PVB

3. Inboard lite: 3/16" thick clear glass – tempered.

2.5 GLAZING SEALANTS

A. General: Use product of one manufacturer. Design recommended by manufacturer.

1. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, laminated glass core, insulating glass seals and glazing channels

a. Silicone Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated, single component, capable of water immersion without loss of properties, non-staining, non-bleeding, cured Shore A Hardness Range of 15 to 25. Color: Grey

i. Structural Silicone: Furnish high-modulus structural silicone glazing materials where sealant bonds glass to substrate.

b. Polyurethane Glazing Sealant: ASTM C920, Type S, Grade NS, Class and use suitable for glazing application indicated, single component chemical curing, non-staining, non-bleeding, Shore A Hardness Range 20 to 35. Color: Grey

c. Structural Silicone (sealant at interior butt joint glazing. Same as item "a" above), Color: Clear.

2. Dense Gaskets: ASTM C864 or ASTM C1115, resilient extruded shape to suit glazing channel retaining slot. Color: Grey

3. Soft Gaskets: ASTM C509, resilient extruded shape to suit glazing channel retaining slot, grey color.

4. Pre-formed Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2

percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal. Color: Grey.

2.6 GLAZING ACCESSORIES

A. Setting Blocks: Elastomeric material recommended by glass manufacturer, 60 to 70 Shore D durometer hardness, length of 0.1 inch for each square foot of glazing or minimum of 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area. For laminated glass or heavy/large units (>= 10 sq. meters and / or 500 kg) an elastic support from maximum 2 mm should be added.

B. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3 inch long x one half the height of glazing stop x thickness to suit application.

C. Glazing Clips: Manufacturer's standard type.

D. Glazing Film: Polyester, pressure-sensitive decorative glass and window film. Fire Rating tested according to ASTM E84 and classified as Class A. Basis of Specification: 3M Fasara Glass Finish.

1. Location: As indicated in Drawings.

2. Pattern: To be selected by Architect from manufacturer's full range of available patterns.

3. Color: To be selected by Architect from manufacturer's full range of available colors.

PART 3 − EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Coordination and project conditions.

B. Verify openings for glazing are correctly sized and within acceptable tolerance.

C. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

A. Unless otherwise shown or specified, perform installation in accordance with GANA Glazing Manual and Sealant Manual.

1. Glazing Sealants: Comply with ASTM C1193. Color to be Grey.

2. Fire Rated Openings: Comply with NFPA 80.

B. Use one of the following glazing methods, all colors to be Grey.

1. Exterior dry method (gasket glazing).

2. Exterior wet/dry method (pre-formed tape and sealant).

3. Exterior (and Interior) wet method (sealant and sealant).

4. Interior dry method (tape and tape).

5. Interior wet/dry method (tape and sealant).

3.4 CLEANING

A. Remove glazing materials from finish surfaces.

B. Remove labels after Work is complete.

C. Clean glass and adjacent surfaces.

3.5 PROTECTION

A. Protect glass from damage after installation. Mark exposed panes with an “X” by using removable plastic tape.

B. Remove and replace glass damaged or broken prior to Substantial Completion at no additional cost to Owner.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Work includes fixed louvers, frames and accessories.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 07 16 20 – Cement Plastering.
3. Section 07 27 26 – Fluid-Applied Membrane Air Barriers
4. Section 07 62 00 – Sheet Metal Flashings and Trim.
5. Section 07 90 00 – Joint Protection.
6. Division 23 – Mechanical.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500- L - Test Methods for Louvers, Dampers, and Shutters.

B. American Architectural Manufacturers Association:

1. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

C. ASTM International:

1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.3 PERFORMANCE REQUIREMENTS

A. Wind Load: Furnish blade wall thickness and integral structural supports, designed by manufacturer, to carry a wind load of not less than 20 psf.

1.4 SUBMITTALS

A. Division 1 – Submittal Procedures: Submittal procedures.

B. Product Data: Submit data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details inclusive of anchorage; blade configuration, screens, blankout areas required, and frames.

D. Samples: Submit minimum 6 inches square with specified finish.

E. Manufacturer's Certificate: Certify products meet or exceed specified performance requirements.

F. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.

a. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.

2. Indoor Air Quality Certificates: Certify volatile organic compound content for each interior adhesive and sealant and related primer.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AMCA Certification for Water Penetration, Air Performance, and Wind Driven Rain, in compliance with AMCA 500-L. Attach AMCA seal to louvers.

1.6 QUALIFICATIONS

A. Manufacturer and Installer: Companies specializing in manufacturing and installing Products specified in this section with minimum three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Product storage and handling requirements.

B. Protect louvers from accelerated weathering by removing or venting sheet plastic shipping wrap.

C. Handle and store pre-finished material off ground with weather protection to prevent twisting, bending, or abrasion, and to provide ventilation.

1.8 COORDINATION

A. Division 1 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with adjacent assemblies, providing sequencing for installation of air and weather barrier and flashing installations.

C. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Product warranties and product bonds. Contractor shall make repairs and replacements upon notification of defects.

1. Furnish 20 year manufacturer warranty against excessive deflection and deterioration of finishes.

PART 2 – PRODUCTS

2.1 WALL LOUVERS – DRAINABLE STYLE

A. Manufacturers: Furnish compliant products of one of the following or approved equal:

1. Construction Specialties, Incorporated.

2. Airolite K6747 (59% free area).

B. System Description: Construction Specialties PL-4080 Perforated High Performance Louver is basis of design.

1. Unit Depth: 7.5-inches maximum.

2. Blade Wall Thickness: 0.068” inches minimum and as required for unit width, integral support spacing.

3. Net Free Area: AMCA 500; 46.8 percent minimum.

4. Maximum Pressure Drop: AMCA 500; 0.20 inch water gauge at 1,000 feet per minute.

5. Water Penetration: AMCA 500; 0.01 oz/sq ft maximum of free area at minimum 822 ft/min face velocity.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

C. Indoor Environmental Quality Characteristics:

1. Adhesives and Sealants: Maximum volatile organic compound content in accordance with Section 01 81 13.

2.3 COMPONENTS

A. Aluminum: ASTM B221; alloy 6063-T5; extruded shape; prefinished with shop applied fluoropolymer finish.

B. Birdscreen: Interwoven aluminum mesh; 0.063 inch; 1/2 inch open weave; removable, rewireable frame.

C. Blank-Off Panels: ASTM B209; 0.040 inch aluminum sheet; factory installed with removable screws and neoprene gaskets.

2.4 ACCESSORIES

A. Fasteners and Anchors: Stainless steel type.

B. Flashings: Of same material as louver frame and specified in Section 07 62 00.

C. Sealants: Elastomeric silicone building sealant as specified in Section 07 90 00.

2.5 FABRICATION:

A. Louver Frame: Channel shape; welded corner joints, 0.081 inch minimum material thickness. Form perimeter of frame with return to retain backer rod for sealant application.

B. Intermediate Mullions: Concealed, profiled to suite louver frame.

C. Head and Sill Flashings: Fabricate to required shape, single length in one piece for each location.

D. Screens and Blank-Off Panels: Factory install on interior of louver.

2.6 ALUMINUM FINISHES:

A. Superior-Performance Organic Finish – Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Apply finish to both sides of panel.

2. Color: Match Glazed Aluminum Curtainwall as specified in Section 08 44 13.

B. Extent of Finish:

1. Apply finish to surfaces cut during fabrication where visible in completed assemblies, including joint edges.

2. Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Coordination and project conditions.

B. Verify prepared openings and flashings are ready to receive Work and opening dimensions are as indicated on shop drawings.

3.2 INSTALLATION

A. Install louvers plumb, level, true, and properly align with adjacent work.

B. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

C. Secure louvers in opening framing with concealed fasteners.

D. Install perimeter backer rod and sealant in accordance with Section 07 90 00.

3.3 ADJUSTING

A. General: Touch-up minor scratches and blemishes with coating manufacturer's recommended product and system; match original finish for color and gloss. Replace damaged units that cannot be repaired to Architect’s satisfaction at no additional cost to Owner.

3.4 CLEANING

A. Clean louver surfaces in accordance with manufacturer’s instructions.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal stud partition framing.
2. Rigidly-framed gypsum board ceilings and soffits.
3. Framing of suspended gypsum board ceilings, complete with hanger wires, braces, backing, trims, and accessories.
4. Miscellaneous interior light gauge framing.
5. Gypsum board panel product, installation and finish on walls and ceilings, including joint treatment.
6. Gypsum sheathing.
7. Fire protection of recessed light fixtures, electric panels, fire extinguisher cabinets, and other accessories where shown recessed in gypsum wallboard systems at fire rated conditions.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 02 41 00 - Selective Demolition: Coordination with existing assemblies to be altered or extended.
3. Section 05 40 00 - Cold-Formed Metal Framing: Exterior stud wall framing system.
4. Section 05 50 00 – Metal Fabrications: Expansion anchors & miscellaneous supports for framing.
5. Section 07 54 23 – Thermoplastic Polyolefin Roofing: Glass mat faced gypsum roofing cover board.
6. Section 07 84 00 – Firestopping: Provision of firestopping materials in fire-resistive penetrations and joints of rated gypsum board assemblies.
7. Section 07 90 00 – Joint Protection: Provision of sealants in gypsum board assemblies.
8. Section 08 12 14 - Standard Steel Frames: Coordination with Gypsum Board Assemblies.
9. Section 09 90 00 - Paints and Coatings: Surface finish and primer/sealer.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C475 - Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
2. ASTM C645 - Non-Load Bearing (Axial) Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
3. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
4. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
5. ASTM C1002 - Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products to Wood or Steel Studs (less than 0.033 inch in thickness).
6. ASTM C1177 - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
7. ASTM C1178 - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
8. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing Board.
9. ASTM C1396 – Standard Specification for Gypsum Board.
10. ASTM C1658 - Standard Specification for Glass Mat Gypsum Panels.
11. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
12. ASTM E119 - Test Methods for Fire Tests of Building Construction and Materials.

B. California Building Code (CBC).

C. Gypsum Association (GA):

1. GA-201: Gypsum Board for Walls and Ceilings.
2. GA-214: Recommended Specification: Levels of Gypsum Board Finish.
3. GA-216: Recommended Specifications for Application and Finishing of Gypsum Board.
4. GA-253: Recommended Specification for the Application of Gypsum Sheathing.
5. GA-600: Fire Resistance Design Manual.

D. ICC Evaluation Service:

1. International Code Council Evaluation Service Reports as referenced herein.

E. Federal Specifications:

1. United States General Services Agency Federal Specifications and Commercial Item Description reports as referenced herein.

F. Underwriters Laboratories, Inc. (UL):

1. Fire Resistance Directory.

G. Warnock Hersey (WH):

1. Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to applicable code for fire rated assemblies in conjunction with Section 07 84 00 as follows:

1. Fire Rated Partitions: Listed assembly by UL as shown, and as required to complete gypsum board assemblies against abutting assemblies.

2. Fire Rated Structural Column Framing: Listed assembly by UL or WHI.

3. Fire Rated Structural Beam Framing: Listed assembly by UL or WHI.

4. Fire Rated Shaft Wall Requirements: 1- and 2-hour in accordance with UL or WHI.

1.4 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturer’s literature and installation instructions for each material and accessory. Clearly identify specified sizes and options intended to be furnished.

C. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.

2. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the referenced documents listed above.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authority Having Jurisdiction.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Store materials inside under cover and stacked flat. Stack gypsum board so that long lengths are not over short lengths.

1.8 PROJECT/SITE CONDITIONS

A. Temperature: Maintain temperature range between 55 degrees and 70 degrees F for 24 hours before, during and after gypsum board and joint treatment application.

B. Ventilation:

1. Provide ventilation during and following adhesive and joint-treatment applications.
2. Use temporary air circulators in enclosed areas lacking natural ventilation.
3. Under slow drying conditions, allow additional drying time between coats of joint treatment.

PART 2 – PRODUCTS

2.1 PARTITION AND RIGID CEILING FRAMING MATERIALS

A. Manufacturers: Furnish compliant products of one of the following, or approved equal.

1. California Expanded Metal Products Company / CEMCO.
2. ClarkDietrich Building Systems LLC.
3. SCAFCO Corporation.
4. Steeler, Incorporated.

B. Studs, Joists and Tracks: ASTM C645 and GA-600, galvanized steel sheet, 16 gauge unless otherwise indicated on Drawings.

1. Material:

18-Gauge and Lighter: ASTM A570, Grade C, steel sheet with corrosion resistant factory finish, 33 ksi yield strength.

16-Gauge and Heavier: ASTM A570, Grade E, steel sheet with corrosion-resistant factory finish, 50 ksi yield strength.

2. Studs and Joists: Non-bearing "cee" type with punched webs and flanges not less than 1-3/8 inches wide, depth as indicated.
3. Track: Steel sheet channel with unpunched webs and flanges not less than 1-1/2 inches wide. Depth as indicated and/or to match interfacing studs or joists.

4. Optional Pre-engineered Long Leg Jamb Studs: 16 gauge steel, flange length 3-inches, return lip of 7/8-inch, depth as indicated, valid ICC-ES Evaluation Report. Cemco's "King Studs", (ICC ESR-4943P) or equal.

5. Slotted Steel Track: Same gauge, depth and finish as interfacing metal studs unless otherwise shown. 2-1/2" deep, vertically-slotted legs to permit up to 1-1/2 inches of total vertical deflection without loading of the studs below. Product shall have a current evaluation report from a recognized testing service. ClarkDietrich's "MaxTrak (SLT)" or equal.

6. Backing Plates and Bracing Straps: 20-gauge steel sheet unless otherwise shown, same finish as interfacing metal studs, and sizes as shown.

C. Sustainability Characteristics: Division 1 – Sustainable Design Requirements: Requirements for sustainable design compliance.

1. Materials and Resources Characteristics:

a. Recycled Content Materials: Furnish stud, joist and track materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

2.2 SUSPENDED GYPSUM BOARD CEILING FRAMING MATERIALS

A. Generic Framing Option: Cold-rolled channel main members with furring channels.

1. Main Carrying Channels at Gypsum Board Suspended Ceiling: 16 gauge, 1-1/2 inch cold-rolled steel carrying channels coated with rust-inhibitive material or galvanized.

2. Furring (Hat) Channels: Roll formed 20-gauge galvanized steel, hat-shaped channels, 2-5/8 inches wide and 7/8-inch deep, with 1/2-inch flanges.

3. Hanger Wires: Size as shown on Drawings. Soft-annealed galvanized steel complying with ASTM C636.

B. Pre-Engineered Framing Option: Heavy-duty classified, concealed suspended tee-grid system. ICC ES-1289. Armstrong's "Drywall Grid – XL 7936 Series". No substitutions.

1. Main Beams: ASTM C635; heavy-duty classified, rotary-stitched double-web construction, ASTM A653 hot dipped galvanized steel. "HD 8900 Series".

2. Cross Tees: Rotary-stitched double-web construction, ASTM A653 hot dipped galvanized steel. "XL 8900 Series".

3. Hanger Wires: Size as shown on Drawings. Soft-annealed galvanized steel complying with ASTM C636.

4. Wall Moldings: Manufacturer's standard.

2.3 MISCELLANEOUS FRAMING MATERIALS

A. Clips and Clip Angles: 20-gauge steel sheet, unless otherwise shown, same finish as interfacing metal studs, and sizes and shapes as shown.

B. Fasteners: Hot-dip galvanized at exterior assemblies and at pressure-treated lumber unless indicated otherwise on drawings.

1. Screws: ASTM C954 or ASTM C1002. Self-drilling, self-tapping hex or pan head.

2. Powder-actuated fasteners: 0.157-inch shank diameter, 1-1/4 inch length unless otherwise noted on Drawings.

3. Expansion Anchors: Refer to 05 50 00 – Metal Fabrications.

4. Welding: In conformance with AWS D1.1 and AWS D1.3.

5. Welding Electrodes: AWS, low hydrogen type, as required.

C. Miscellaneous Framing Accessories: Manufacturer's standard, suitable for use intended.

2.4. GYPSUM PANEL MATERIALS

A. Manufacturer: Compliant products of one of the following, or approved equal. Products of Georgia-Pacific are listed below as the specified basis.

1. Georgia-Pacific Corporation.

2. National Gypsum Company.

3. United States Gypsum Company.

B. Gypsum Board: Paper-faced ASTM C1396, fire-resistive type throughout unless otherwise shown or specified. 5/8-inch thick or as indicated, maximum available length in place; tapered edges. “ToughRock Fireguard”.

C. Moisture-Resistant Gypsum Board: Fiberglass mat-faced ASTM C1658, fire-resistive type where indicated. Mold-resistant and paintable. 5/8-inch thick or as indicated, maximum available length in place. “DensArmor Plus High Performance Interior Panel”.

D. Gypsum Tile Backer Board: Fiberglass mat-faced ASTM C1178 when furnished in 5/8” thickness, anti-microbial, built-in moisture barrier and moisture-resistant core. ANSI A118.9-compliant. 5/8-inch thick or as indicated, maximum available length in place. “DensShield Tile Backer”.

E. Gypsum Sheathing: ASTM C1177; fiberglass mat-faced gypsum core, 5/8 inch thick or as indicated, maximum available length in place. “DensGlass Gold”.

F. Fasteners: ASTM C1002, Type S, Philips head bugle shape screws. Provide rust-resistant at Gypsum Tile Backer Board and Gypsum Sheathing. Sizes as required by code and as recommended by gypsum panel manufacturer.

2.5 ACCESSORIES

A. Blanket (Batt) Thermal and Acoustic Insulation: Refer to Section 07 21 16 – Blanket Insulation.

B. Acoustic Sealant: Refer to 07 90 00 – Joint Protection.

C. Corner Beads: Galvanized or aluminum.

D. Edge Trim: GA-216; Type LC bead, galvanized or aluminum.

E. Control Joints: Miscellaneous factory-primed aluminum extrusions suitably finished for field painting with acrylic latex paint. Reveal width as indicated. Extrusions shall feature fins suitable for screw anchorage and finished over with tape and joint compound. Control Joints shall include concealed continuous compression seals. Pittcon “Softforms”, Fry Reglet “Reveal Molding”, or equal.

F. Gypsum Board Joint Materials:

1. Joint Tape: ASTM C475; 2-inch cross-fibered paper. At Moisture-Resistant Gypsum Board and Gypsum Tile Backer Board, furnish alkali-resistant glass fiber tape.

2. Joint Compounds: ASTM C475, ready-mix, non-asbestos, vinyl formulation joint compound. At Moisture-Resistant Gypsum Board and Gypsum Tile Backer Board, use tile-setting mortar or adhesive.

3. Adhesive: Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum base panels to face panels in multilayer construction.

4. Repair Tape: U S Gypsum “Sheetrock Fiberglass Drywall Tape”, self-adhesive.

G. Outlet Box Pads used for Fire-Rated or Acoustical purposes: Refer to 07 84 00 – Firestopping.

~~H. Mullion Closures: Used for gap closure between end of partitions and glazing system mullions. Aluminum, factory spring-loaded, self-gasketing, nominally 2-inch wide by required depth. Minimum STC: 38. Finish: Custom to match glazing system mullion. Gordon Interior Specialties’ “Mullion Mate” or approved equal.~~

H. Mullion Closures: Used for visual gap closure, acoustical and fire-resistive separation at intersection of interior partitions with continuous interior or exterior glazing system.

1. Non-Fire-Rated Partition Assemblies: Continuous, spring-loaded, self-gasketing, aluminum assembly designed to fill gap between end of partition and back of vertical glazing system mullion. Basis of Specification: Gordon Interior Specialties’ “Mullion Mate” or approved equal.

a. Size: 2-inches wide nominal, depth as required to fill gap.

b. Sound Transmission Class (STC): 38 minimum, unless indicated otherwise.

c. Aluminum Finish: AAMA 2605, custom color to match glazing system mullion.

2. Fire-Rated Partition Assemblies: Aluminum with ASTM E84, Class 1 foam infill and continuous gasketing for face of glass. Assembly to encapsulate window mullion for complete acoustical separation. Basis of Specification: MULL-it-OVER Products' "Mullion Trim Cap" series or approved equal.

a. Depth: As required to encapsulate glazing system mullion.

b. Sound Transmission Class (STC): 55 minimum, unless indicated otherwise.

c. Fire Rating: One- or Two-Hour options to match interior partition assembly rating, UL Assembly tested.

d. Aluminum Finish: AAMA 2605, custom color to match glazing system mullion.

I. Sound Isolation Clips: Engineered with resilient isolation material for installation on steel wall studs and application of horizontal furring channels. Listed with UL for optional use on fire-resistive wall assemblies to two-hour minimum. Furnish one of the following or approved equal:

1. Kinetics Noise Control, Incorporated's "Isomax".
2. Pliteq, Incorporated's "Genie Clip".
3. PAC International, Incorporated's "RSIC-1".

J. Miscellaneous Items: Provide components not specified but shown and provide other items and accessories required for complete installation.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Coordination and project conditions.

B. Verify site conditions are ready to receive work and opening dimensions are as instructed by manufacturer.

3.2 GENERAL

A. Install Work plumb, level, true, straight and rigid per reference standards, manufacturer's recommendations, and as specified.

B. Tolerances: Do not vary from true plane greater than 1/8-inch in 8 feet, measured in any direction.

C. Do not bridge building expansion or seismic joints with framing or furring members. Independently frame both sides of joints with framing or furring members.

D. Frame and reinforce openings for doors, windows, ducts, access panels, and other openings and items as shown or per referenced standards.

E. Install accessories and miscellaneous specialties plumb, true and level. Install other materials and items as required as part of the Work of other Sections.

F. Install and tighten expansion anchors in accordance with manufacturer's recommendations and referenced Reports. Coordinate for inspection and testing as required. Clean and repair surfaces damaged by drilling or installation and fill abandoned holes with patching mortar in accordance with the manufacturer's instructions. Correction of defective work shall be the responsibility of the Contractor.

3.3 INTERIOR WALL AND PARTITION INSTALLATION

A. Frame from floor to structure above with metal studs at 16 inches on center, unless otherwise shown.

1. Fasten floor track and slotted top track to structure as shown, 2 inches from ends and with spacing not to exceed that of studs.

2. Secure metal studs in tracks with sheet metal screws as indicated. Fasten studs to slotted top tracks through centers of slotted holes as shown.

B. Brace studs as shown, including at locations that will not receive gypsum panels.

C. Provide backing as scheduled and detailed and of sufficient length to fasten each end to metal framing. Provide backing support for each point of fastening of every unit to be anchored.

D. Resilient Channel: Attach resilient channels, where required, on 16-inch centers perpendicular to stud framing.

1. Drive screws only through pre-punched holes in channels.

2. Attach resilient channels with mounting flanges facing in only one direction. Orient the gap between the channel and stud faces upward on walls.

3. Hold back ends of channels 1/2 to 3 inches from intersecting surfaces.

4. Splice channels only at studs and overlap ends by not more than 1-1/2 inches.

5 Locate channels so that gypsum board will not be cantilevered more than 6 inches from vertical surfaces.

3.4 CEILING SUPPORT INSTALLATION

A. Rigidly frame or install suspended gypsum panel ceiling system as indicated on drawings. Seismically brace suspended framing as indicated.

3.5 ACOUSTIC ACCESSORIES INSTALLATION:

A. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

B. Install Outlet Box Pads at all boxes within partitions identified as fire-rated or acoustical.

3.6 GYPSUM PANEL INSTALLATION (INTERIOR):

A. General: Comply with applicable requirements of specified reference standards, except where more stringent requirements are specified; mandated by local codes; or by manufacturer of gypsum board.

1. End Joints: Neatly fit and stagger.

2. Joints: Locate on different studs at opposite sides of partition.

3. Workmanship: Install Work with plumb and straight surfaces, with no waves or buckles, and free of unevenness at joints.

B. Ceilings:

1. General: Apply gypsum board with long dimension at right angles to horizontal supports.

2. End Joints: Provide with solid bearing.

C. Partitions:

1. General: Apply gypsum board with long dimensions perpendicular to studs and with all abutting edges over supports.

a. Start application at corner of room or space.

b. Stagger joints to occur on different framing members on opposite sides of partitions wherever possible.

c. Do not place butt ends against tapered edges.

d. Cut, fit neatly around outlets, switches, and other penetrating items.

e. Cut gypsum board to not more than 1/4-inch of penetrating ducts, pipes, conduit, outlet boxes, and other penetrating items.

D. Fastening:

1. Attach gypsum board with specified fastener type. Space fasteners per more stringent of specified Reference Standards or UL standards. Stagger opposite each other on adjacent ends or edges.

2. Drive screws with power screwdriver recommended by gypsum board manufacturer. Do not hammer-drive screws.

3. Set fastener head slightly below surface of gypsum board. Do not break through facing surface of gypsum board.

4. Omit fasteners at edges where metal edge trim will be installed.

5. When furring channels are used with sound isolation clips, attach gypsum board to furring channel only. Do not allow gypsum screws to contact studs.

E. Double-Layer Installation:

1. Install first layer per requirements specified above and finish to Level 2 as specified below.

2. Screw fasten second layer similarly. Orient second layer of panels in either direction. Stagger joints and abut vertical joints over studs.

F. Metal Trim:

1. General: Apply trim at exterior corners and at interior corners where gypsum board intersects metal or other dissimilar materials.

2. Trim Lengths: Install in longest lengths practicable.

3. Trim: Run straight and square with planes.

4. Edges: Apply applicable shape metal edge trim at exposed edges of gypsum board and where otherwise shown. Where gypsum panel abuts other materials, install edge trim with 1/8-inch clearance to allow for caulking, unless otherwise shown.

5. External Corners: Apply cornerbeads at external corners and where otherwise shown in single lengths.

6. Install control joints as indicated. Install straight, level and plumb. Align with corners of openings and other elements. Confirm with Architect the requirements for control joints where not indicated at continuous gypsum board surfaces 30 feet or greater in length.

G. Perimeters, Penetration, and Openings: Seal all perimeter material transitions, penetrations, outlet boxes, and openings.

1. Acoustic Partitions: Install Acoustic Sealant and install and seal other gaps per requirements on drawings and as specified in Section 07 90 00.

2. Fire-Rated Partitions: If partition is fire-rated, install fire-stopping in lieu of acoustic sealant as specified in Section 07 84 00.

3.7 GYPSUM PANEL TAPING AND FINISHING:

A. Level 1: Provide in plenums, attics, and other concealed areas. All joints and interior angles shall have tape set in joint compounds. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.

B. Level 2: Not Used.

C. Level 3: Not Used.

D. Level 4: Provide in areas where flat and eggshell paints, light textures, or wall coverings are to be applied. All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compounds shall be smooth and free of tool marks and ridges.

E. Level 5: Provide at locations where indicated and at all locations scheduled to receive paints with semi-gloss and gloss sheen as defined under Section 09 90 00. Finish gypsum board, after taping and finishing specified under Level 4 above, as follows.

1. Apply a thin skim coat of joint compound to entire surface of gypsum board. Apply in manner to minimize suction, porosity, and other surface variations between joint compound and face paper surface. Take special care to eliminate lap and tool marks during application.

F. General: Apply joint compound and joint tape per manufacturer's directions.

G. Acoustical Sealant: Do not apply joint tape and joint compound over joints containing acoustical sealant until sealant has completely cured.

H. Tape: Center tape over joints and embed in uniform layer of joint compound of sufficient width and depth to provide form and complete bond.

1. Apply skim coat while embedding tape.

2. At Moisture Resistant Gypsum Board and Tile Backer Board, fill fastener heads, penetrations, and joints with tile setting mortar or adhesive and use alkali-resistant glass-fiber tape.

I. Angles: Treat with joint tape folded to conform to adjacent surfaces and straight, true angles.

J. Drying Time: Provide minimum 24 hours between applications of compound.

K. Finishing Compound: Apply coat over joint compound and tape.

1. Spread evenly and feather out beyond edge of board.

2. After first finishing coat is thoroughly dry, cover with second coat with edges feathered out slightly beyond the preceding coat.

3. Apply third coat if required to visually conceal gypsum board joints.

L. Fastener Depressions: Give dimples at fastener heads and marred spots on surface of gypsum board one coat joint compound and two coats finishing compound. Apply in same manner as for joints.

M. Metal Trim: Conceal flanges with minimum two coats compound. Extend compound 8 to 10 inches each side of metal nosing.

N. Sanding: After each application of joint or finishing compound has dried, lightly sand joints. Leave gypsum board and treated areas uniformly smooth and ready for painting or other decoration.

3.8 GYPSUM SHEATHING INSTALLATION:

A. General: Comply with ASTM C1280, GA-253 and manufacturer's written instructions, except where more stringent requirements are specified; mandated by local codes; or by manufacturer of gypsum board.

B. Orient sheathing vertically (parallel with framing) and abut ends and/or edges of the boards centered over face of framing members. Offset board joints by not less than one stud spacing.

C. Cut panels at penetrations, edges, and other obstructions of work; fit closely against abutting construction unless otherwise indicated.

D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion or deflection joints; cut and space edges of panels to match spacing of supporting elements.

F. Install boards with a 1/4-inch gap where they abut concrete or similar material that might retain moisture, to prevent wicking. Install with a 3/8-inch gap where structural elements, plumbing and conduit penetrate sheathing, unless otherwise noted. Seal all gaps per Division 7.

G. Fasten sheathing to cold formed metal framing with screws with power screwdriver recommended by gypsum board manufacturer. Do not hammer-drive screws. Locate fasteners not less than 3/8 inch from ends and edges of sheathing, spaced at 4 inch centers along vertical sides and 8 inch centers along intermediate supports. Set fastener heads at or slightly below surface of sheathing.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Metal suspension system for the support of gypsum drywall in ceiling, a soffit installation for interior and exterior finishes.

1.2 RELATED SECTIONS

A. Section 09 51 00 (09510) - Acoustical Ceilings

B. Section 09 20 00 (09250) - Plaster and Gypsum Board

C. Section 01 81 13 - Sustainable Design Requirements

D. Section 01 81 19 - Indoor Air Quality Requirements

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

a) ASTM A 1008 Standard specification for the Steel, Sheet, Cold Rolled Carbon, Structural, High Strength Low-Alloy and High Strength Low Alloy with Improved Formability

b) ASTM A 641 Standard Specification for Zinc Coated (Galvanized) Carbon Steel Wire.

c) ASTM C 635 Standard Specification for Metal Suspension Systems

d) ASTM C 645-09 - Standard Specification for Nonstructural Steel Framing Members

e) ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

f) ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Material

l) ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint

g) ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

n) International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

o) LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

p) International Code Council Evaluation Service Report ESR-1289 for Drywall Grid

q) IAPMO Evaluation Report for ShortSpan ER0163

1.4 SUBMITTALS

A. Product Data:

Submit manufacturer's technical data for each type of Metal Framing system required.

B. Samples:

Metal Framing System, including main runner and 4 foot cross tees.

C. Shop Drawings:

Layout and details of Metal Framing System. Show locations of items which are to be coordinated with, or supported by the metal suspension system.

1.5 QUALITY ASSURANCE

A.

Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

B.

Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturer's installation instructions.

C.

Fire Resistance Characteristics: For fire-resistance-rated assemblies that incorporate Metal framing systems provide materials and construction identical to those tested in fire resistance assembly as indicated in the construction documents and or architectural plans in accordance with ASTM E119.

1.6 SUSTAINABLE MATERIALS

Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency,

Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.

1. Health Product Declaration. The end use product has a published, complete Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration open Standard.

2. Declare Label. The end use product has a published Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).

3. Low Emitting products with VOC emissions data. Preference will also be given to manufacturers that can provide emissions data showing their products meet CDHP Standard Method v1.1 (Section 01350).

4. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.

5. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.

6. Products meeting LEED V4 requirements including:

Storage & Collection of Recyclables

Construction and Demolition Waste Management Planning

Building Life-Cycle Impact Reduction

Building Product Disclosure and Optimization Environmental Product Declarations

Building Product Disclosure and Optimization Sourcing of Raw Materials

Building Product Disclosure and Optimization Material Ingredients

Construction and Demolition Waste Management

1.7 DELIVERY, STORAGE AND HANDLING

Protect and store products in manufacturer's unopened packaging until ready for installation.

1.8 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.

1.9 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping

2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Grid: One (1) year from date of substantial completion

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A.

Suspension Systems:

1. Armstrong World Industries, Inc.

B.

Aluminum Custom Perimeter Trim Extruded:

(a) Armstrong World Industries, Inc.

C.

Perimeter Systems:

1. Armstrong World Industries, Inc.

2.2.1 DRYWALL SUSPENSION SYSTEMS

A. Armstrong Drywall Suspension Systems all main beams and cross tees shall be commercial quality hot-dipped galvanized steel

1. Tee: manufactured main beam- 1-1/2" knurled face with ScrewStop™ reverse hem by 1-11/16 inches high. Drywall Main Beams are factory punched with crosstee routs and hanger wire holes and SuperLock™ main beam clip for a strong secure connection and fast accurate alignment. Both ShortSpan and Drywall Main Beams are Heavy-duty performance per ASTM C635

HD7940 - 3600mm Drywall Furring Main Beam 38mm

2. Cross Tees: manufactured main beam- 1-1/2" knurled face with ScrewStop™ reverse hem by 1-1/2 inches high with factory punched cross tee routs and hanger wire holes and XL stake on clip for a strong secure connection.7930 - 1200mm Drywall Cross Tee

3. Wall Molding:

7856 - 10ft F Molding for 5/8" Gypsum

4. Hanger wire: a Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three times the design load, but not less than 12-gauge.

5. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label

6. Life Cycle Assessment: Third Party Certified Environmental Product Declaration (EPD)

PART 3 – EXECUTION

3.1 EXAMINATION

A:

Prior to installation, inspect previous work of all other trades. Verify that all work is complete and accurate to the point where this installation may properly proceed in strict accordance with framing shop drawings.

B.

If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C.

Installation: In accordance with all approved plans, details, and manufacturer's installation guidelines located in the Armstrong Drywall Grid Systems and ShortSpan Installation Guides.

(1) Install seismic components if required by the building code. Seismic components to be specified on the architectural plans by the project engineer or design team.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes Portland cement plaster system with integral color, acrylic-modified finish over cement plaster base coat(s), including building paper, lath and accessories**.**

1. Three-coat system over building paper and lath at gypsum sheathing and rigid insulation substrates.

2. Two-coat system over bonding compound at concrete and concrete masonry unit substrates.

3. Anti-Graffiti coating at ~~First Floor~~ areas**/heights indicated on Construction Drawings**.

B. Related Sections:

1. Section 05 40 00 - Cold-Formed Metal Framing: Structural metal studding and framing **and sub-framing** behind plaster base.

2. Section 07 21 13 – Board Insulation: Continuous insulation used in exterior wall assemblies.

3. Section 07 27 14 – Self-Adhered Sheet Air Barriers: Air and weather barrier beneath building paper.

4. Section 09 21 16 - Gypsum Board Assemblies: Exterior sheathing.

1.2 REFERENCES

A. ASTM International:

1. ASTM C150 - Standard Specification for Portland Cement.

2. ASTM C206 - Standard Specification for Finishing Hydrated Lime.

3. ASTM C847 - Standard Specification for Metal Lath.

4. ASTM C897 - Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters.

5. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster.

7. ASTM C1002 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases.

8. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.

9. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.

B. Federal Specification Unit:

1. FS UU-B-790 - Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant).

1.3 SUBMITTALS

A. Division 1 - Submittal procedures.

B. Product Data: Submit data on each lathing material and accessory, plaster materials, and characteristics and limitations of products specified. Include proposed method for curing scratch coat.

C. Shop Drawings: Indicate locations of proposed control and expansion joints where not indicated on Drawings.

D. Samples: Submit 12 x 12 inch in size illustrating finish color and texture.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C926. Obtain Architect's approval of scratch coat curing methodology via Submittal process.

B. Qualified Manufacturer and Installer: Companies specializing in manufacturing products specified in this section with minimum five years' experience.

C. Quality control of plaster mixes is imperative. Field-mixed plaster materials will not be accepted.

D. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include Owner Representatives, Architect, Contractor, and subcontractors whose work is relevant to this Specification Section.

E. Mockup: Construct mockup of cement plaster, minimum 100 square feet in area, including typical expansion joint intersection and specified plaster color and finish.

1. Reconstruct the mock-up as many times as necessary to meet Architect's approval, without additional cost to the Owner. The approved mock-up will establish both a technical and aesthetic standard for the remainder of the project including the installation of lath and accessories, the mixing and application of the plaster (for color and texture) and the curing of the plaster (for crack control).

2. The mockup shall be separate from the final construction and shall be removed from the site at the direction of the Owner's representative. Only at the Architect's discretion may the approved mockup become part of the permanent finish.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Division 1 - Product Requirements.

B. Do not apply plaster unless minimum ambient temperature of 40 degrees F has been and continues to be maintained for minimum 48 hours prior to application and until plaster is cured.

C. Take precautionary measures to ensure plaster is not subjected to excessive sun and wind which could cause uneven and excessive evaporation, premature dehydration, or cracking. Provide opaque tarpaulins or other temporary means of protection when weather conditions warrant.

1.6 WARRANTY

A. General: Warranties shall pay for all costs associated with repairs and replacement upon notification of defects.

B. Material Warranty: Manufacturer shall warrant cement plaster and acrylic finish materials bearing its name on the label against defects for ten years, regardless of the source of manufacture.

PART 2 – PRODUCTS

2.1 METAL LATH

A. Expanded Metal Lath: ASTM C847, with ASTM A653 G60 galvanized coating, diamond mesh, self-furring to hold face 1/4 inch from backing, not less than 3.4 pounds per square yard.

2.2 BASE-COAT CEMENT PLASTER

A. Plaster Base Materials: Pre-mixed, engineered material with fiber for scratch and brown coat complying with ASTM C926 and below.

1. Cement: ASTM C150, Type I Portland cement.
2. Lime: ASTM C206, Type S.
3. Aggregate: ASTM C897.
4. Fiber: ASTM C1116, 1/2-inch nominal length alkaline-resistant glass or polypropylene fibers specially formulated for base coats. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber per cubic yard of cementitious materials.
5. Water: Clean, fresh, potable and free of mineral or organic matter capable of affecting plaster.

B. Portland Cement Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

2. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Portland Cement Base-Coat Mixes for Base-Coat Mixes for Use over Low-Absorption Concrete: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

D. Portland Cement Base-Coat Mixes for Base-Coat Mixes for Use over High-Absorption Concrete Unit Masonry: Single base (scratch) coat for two-coat plasterwork on high-absorption plaster bases as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

2.3 CRACK RESISTANT BASE COAT

A. Apply in thin layer over plaster brown coat and embed reinforcing mesh.

1. Polymer-Modified Basecoat: Fiber-reinforced, 1/8-inch thick nominal.

2. Reinforcing Mesh: ASTM C1116, alkali-resistant glass fiber, 4-1/2 ounces per square yard, treated as necessary for full compatibility with related materials.

2.4 FINISH COATS

A. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems formulated with colorfast mineral pigments and fine aggregates; for use over cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.

1. Manufacturers: Furnish compliant product of one of the following or approved equal:

a. BMI Products, Incorporated.

b. Senergy / BASF Wall Systems.

c. STO Corporation.

2. Color: Match Architect’s sample.

2.5 ACCESSORIES

A. Metal Accessories: Comply with ASTM C1063. Furnish as specified and indicated on the Drawings to match the following:

1. Expanded Metal Lath: ASTM C847, galvanized, diamond mesh, self-furring to hold face 1/4 inch from backing, not less than 3.4 pounds per square yard.

2. Casing Bead: ASTM C1047; formed zinc, No. 66X profile, depth governed by plaster thickness, maximum possible lengths, expanded metal flanges, with square edges.

3. Corner Bead: ASTM C1047; formed zinc, No. 1A profile, depth governed by plaster thickness, maximum possible lengths, expanded metal flanges with straight edge.

4. Base Sill Screed: ASTM C847; formed galvanized sheet steel, No. 36 profile, depth governed by plaster thickness, maximum possible lengths, solid flanges, weep holes, without full return below edge.

5. Strip Mesh: Expanded metal lath, minimum 0.018 inch thick, 2 inch wide x 24 inch long; galvanized.

6. Control Joint Accessories: ASTM C1047; formed zinc, No. 15 accordion ("Double-V") profile, 2 inch expanded metal flanges each side.

7. Channel Screed: Single piece, extruded 6063 T5 aluminum alloy. Depth governed by plaster thickness, reveal width as indicated on Drawings, maximum possible lengths, mill finish.

8. "X" Corner Molding: Single piece, extruded 6063 T5 aluminum alloy to form "negative" outside corners. Depth governed by plaster thickness.

9. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.

10. Fasteners: ASTM C1002, self-drilling, self-tapping Type S screws.

11. Custom Column Ring: Gordon Incorporated's "PR-3X4".

B. Backing Material: FS UU-B-790a, Type I, Grade D, Style 2 vapor-permeable building paper.

C. Bonding Compound: ASTM C932, tinted. Compound will not re-emulsify, re-wet or re-tackify.

2.6 ANTI-GRAFFITI COATING

A. Non-Sacrificial, clear drying, odor-free, two-part system composed of sealer and wear coating. Rainguard Brands, LLC "Vandlguard" or compliant, approved equal.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Ensure all wall framing, installation of utilities and other accessories to be installed in wall cavity are complete and inspected prior to covering with cement plaster work. Furnish additional framing and backing required for proper securement of plaster accessories, including vertical joints and reveals.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Clean surfaces to receive plaster. Remove loose materials and other deleterious substances with may impair work.

B. Do not conceal weather barrier and rigid insulation until field quality control inspections and corrective work is complete.

3.3 INSTALLATION OF METAL LATH

A. Do not install metal lath at concrete and masonry substrates. Proceed directly to “Installation of Accessories” article below.

B. Isolation: Isolate lathing and metal support system where it abuts building structure horizontally, and where partition/wall work abuts overhead structure, to prevent transfer of building loads into plaster.

C. Installation of Lathing Materials:

1. Apply one layer of Grade D building paper over weather barrier and **gypsum sheathing** substrate **as well as over rigid insulation**; lap edges horizontally in waterfall arrangement, 2 inches minimum. Fasten in place.

2. Install metal lath in accordance with ASTM C1063. Apply lath taut, with long dimension perpendicular to supports; secure end laps with tie wire where they occur between supports; lap sides minimum 1-1/2"; secure with tie wires.

3. Place strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

4. Place strip mesh at junctions of dissimilar materials; place parallel with dissimilar materials; secure rigidly in place.

3.4 INSTALLATION OF ACCESSORIES

A. Install metal accessories in accordance with ASTM C1063.

B. Place corner bead at external wall corners; fasten at outer edges of lath only at maximum 12 inches on center.

C. Place casing beads at terminations of plaster finish. Use single length of metal beads wherever length of run does not exceed longest standard stock length available; miter or cope corners. Butt and align ends. Secure rigidly in place.

D. Provide casing beads where plaster abuts dissimilar construction and at perimeter of openings where edges of plaster will not be concealed by other work.

E. Install door and glazed frames plumb and level in opening. Secure rigidly in place.

F. Install sill and drip screeds with paper sheathing and lath installed over attachment flange of screeds.

G. Control Joints:

1. Install control joints where indicated on Drawings and so plaster areas do not exceed 120 square feet, and with area sides having a maximum one to two and a half (1:2-1/2) ratio, unless otherwise approved by Architect.

2. Coordinate joint placement with other related work. Where joints meet frames at openings, align with outside corners.

3.5 APPLICATION OF BASE-COAT CEMENT PLASTER

A. Masonry and Concrete Substrates: Apply Bonding Compound to unit masonry and concrete surfaces for direct application of plaster.

B. Apply plaster in accordance with ASTM C926. Work shaded surfaces, providing temporary shading as necessary to avoid application in direct sunlight.

C. Walls and Ceilings - Portland Cement Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats with 3/4-inch total thickness for three-coat plasterwork as follows:

1. Apply first, “scratch” coat to lath to a nominal thickness of 3/8 inch, scored horizontally for mechanical key. Moist cure for a minimum 48 hour period.

2. Apply second, “brown” coat to nominal thickness of 3/8 inch, using straightedge to bring surface to a true, even plane, flush with plaster grounds. Float surface with a wood or hard rubber float to promote densification and ensure a surface with adequate “tooth” receptive to bonding of the finish coat.

3. Provide minimum of 2 days of moist curing. Provide additional moist curing to conform to manufacturer’s recommendations, weather conditions and local code criteria, and as otherwise necessary to provide an acceptable substrate for finish work.

D. Wall and Ceilings - Portland Cement Base-Coat Mixes for Use over Concrete or Concrete Masonry Units for two-coat plasterwork as follows:

1. Apply base coat over Concrete Masonry Units with Bonding Compound to a thickness of 3/8-inch.

2. Apply base coat over Concrete with Bonding Compound to a thickness of 1/4-inch.

3. Moist cure for a minimum 48 hour period.

E. Crack Resistant Base Coat Application:

a. Ensure that the surface of the base coat is cured, clean, dry and free of efflorescence, oil or other contaminants that would impair adhesion.

b. Apply polymer-modified mixture in continuous layer approximately 3/32-inch thick.

c. Apply a layer of reinforcing mesh into the wet mixture and trowel smooth until mesh is fully embedded. Lap adjoining pieces of mesh 2-1/2 inches minimum and as required in the manufacturer's written instructions.

d. Cure for a minimum of 24 hours, until dry, or longer as required by weather conditions.

3.6 APPLICATION OF CEMENT PLASTER FINISH COATS

A. Plaster Finish Coats: Apply to provide smooth finish to match Architect's sample.

B. Ensure that the surface to be finished is clean, dry and free of any contaminants that would impair adhesion.

C. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

1. Apply finish to natural breaks to avoid visible cold joints.

2. Work shaded surfaces, providing temporary shading as necessary to avoid application in direct sunlight.

3.7 ERECTION TOLERANCES

A. Maximum Variation from Flat Surface: 1/4 inch in 10 feet.

3.8 ADJUSTING

A. Cut, patch, point, and repair plaster as necessary to accommodate other work and to restore cracks, dents, and imperfections.

B. Repair or replace work to eliminate blisters, buckles, crazing, check cracking, dry-outs, efflorescence, sweat-outs, and similar defects.

C. Finish cutting and patching to match undamaged plaster; patching shall not be visible in finished installation.

3.9 APPLICATION OF ANTI-GRAFFITI COATING

A. Apply to First Floor Areas of Acrylic Finish in accordance with manufacturer's written instructions.

3.10 CLEANING

A. Remove temporary protection and enclosure of other work after plastering is complete.

B. Promptly remove plaster from surfaces not indicated to be plastered.

C. Repair surfaces stained, marred or otherwise damaged during plastering.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Work includes interior ceramic wall tiling and floor tiling with or without waterproofing and isolation membrane; solid surface door thresholds.

B. Work Specified Elsewhere:

1. Section 07 90 00 – Joint Protection: Sanitary sealant.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A108.5 - Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
2. ANSI A108.6 - Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy.
3. ANSI A108.10 - Installation of Grout in Tilework.
4. ANSI A108.13 - Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
5. ANSI A118.3 - Specifications for Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy.
6. ANSI A118.4 - Specifications for Latex-Portland Cement Mortar.
7. ANSI A118.7 - Specifications for Polymer Modified Cement Grouts for Tile Installation.
8. ANSI A137.1 - Specifications for Ceramic Tile.

B. American Society for Testing and Materials (ASTM)

1. ASTM C270 - Standard Specification for Mortar for Unit Masonry

C. Tile Council of North America, Inc. (TCNA):

1. TCNA - Handbook for Ceramic Tile Installation.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements

1. Slip Resistance: ANSI A137.1; Dynamic Coefficient of Friction (DCOF) 0.42 or greater for tile used on floors.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating specified requirements.

B. Samples: Furnish sufficient samples to establish full range of colors and textures for materials exposed in the finished Work. Label samples to indicate product and location in the Work. Samples will be reviewed for appearance only. Compliance with other requirements is the responsibility of the Contractor.

1. For Initial Selection: Manufacturer's color charts consisting of actual tiles or sections of tile showing full range of colors, textures, and patterns available for each type and composition of tile indicated. Include samples of grout and accessories requiring color selection.

2. For Verification: For products which involve color and texture variations, submit sets showing full range of variations expected.

a. Tile: Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on plywood or hardboard backing and grouted.

b. Trim and Accessories: Full-size units of each type for each color required.

c. Thresholds: 6-inch lengths.

d. Metal Edge Strips: 6-inch lengths.

C. Quality Assurance/Quality Control Submittals:

1. Test Reports: Slip Resistance Test Reports.

D. Closeout Submittals:

1. Maintenance Data.

1.5 QUALITY ASSURANCE

A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

B. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

B. Storage and Protection: Protection: Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. Handling: Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.7 PROJECT/SITE CONDITIONS

A. Environmental Conditions: Maintain and protect Work during and after installation per Reference Standards and manufacturer's printed recommendations.

B. Ventilation: Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

C. Temperature: Maintain temperatures at 50 degrees F. (10 degrees C.) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by Reference Standards or manufacturer's instructions.

1.8 MAINTENANCE

A. Extra Materials:

1. General: Deliver extra materials to Owner at Project site. Furnish extra materials that match products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.

2. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern and size.

PART 2 – PRODUCTS

2.1 CERAMIC TILE

A. General: ANSI 137.1; 20 percent minimum recycled content.

B. Ceramic Tile ‘CT1’ – See finish plans. Ceramic Floor Tile.

C. Ceramic Tile ‘CT2’ – See finish plans. Ceramic Wall Tile.

D. Ceramic Tile “CB1” – See finish plans. Match wall tile.. Coved tile base.

2.2 MORTAR AND GROUT

A. Manufacturers: Furnish products of one of the following or approved equal:

1. Custom Building Products.

2. Laticrete International, Incorporated.

3. Mapei International.

B. Thin-Set / Bond Coat: ANSI 118.4; single-step, polymer-fortified, cementitious thin-set mortar. Basis of Specification: Laticrete International, Inc.'s "254 Platinum".

C. Thick-Bed Mortar: ASTM C270; TCNA Extra-Heavy service rating; single-step, polymer-fortified, portland cement mortar. Basis of Specification: Laticrete International, Inc.'s "3701 Fortified Mortar Bed".

D. Grout: ANSI 118.3; water-cleanable, moderate chemical-resistant, non-sagging, sanded epoxy compound suitable for specified joint widths. Basis of Specification: Laticrete International, Inc.'s "SpectraLock PRO Premium Grout".

1. Colors:

a. Floors: To be selected from manufacturer's extended selection.

b. Walls: To be selected from manufacturer's extended selection.

2.3 ACCESSORIES

A. Bonded Waterproofing and Crack Isolation Membrane: ANSI A118.10; load-bearing, liquid rubber polymer with reinforcing fabric. Basis of Specification: Laticrete International's "Laticrete 9235".

B. Cleavage Membrane: ANSI A108.1A; unbonded.

C. Wire Reinforcing: ANSI A108.1A; 16 gauge, 2 inch x 2 inch.

D. Solid Surface Thresholds: ASTM E84, Class A; resinous polymer with homogenous color throughout. Honed finish, 1/2 inch high, 2 inches deep and full width of wall or frame opening, beveled one side as shown on drawings, radiused edges from bevel to vertical face. Dupont's "Corian" or approved equal. Color: To be selected.

2.3 MIXES

A. General: Mix mortars and grout per Reference Standards and manufacturer's recommendations, including those requirements for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Coordination and project conditions.

B. Verify inserts, accessories, plumbing, and similar items are placed or provided for.

C. Verify surfaces are ready to receive work.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install Gypsum Tile Backer Board as specified elsewhere. Tape joints and corners with 2-inch wide alkali-resistant glass fiber mesh tape, cover with skim coat of dry-set mortar to feather edge.

3.3 INSTALLATION SYSTEMS

A. General: Install membranes, tile, thresholds, and grout in accordance with manufacturer's recommendations, applicable requirements of ANSI A108.1 through A108.10, and TCNA Handbook recommendations for systems specified.

B. Floor Installation - Thin-Set Methods:

1. Over interior concrete slab on-grade substrates, install in accordance with TCNA Handbook Method F115. Waterproofing membrane is not required.

2. Over interior elevated concrete substrates, install in accordance with TCNA Handbook Method F115A. Furnish waterproofing membrane.

C. Floor Installation - Mortar-Set Methods:

1. Over interior concrete slab on-grade substrates, install in accordance with TCNA Handbook Method F121. Furnish cleavage membrane and reinforcing. Bonded waterproofing membrane is not required.

2. Over interior elevated concrete substrates, install in accordance with TCNA Handbook Method F121. Furnish cleavage membrane, reinforcing and waterproofing membrane.

D. Wall Installation:

1. Over coated glass mat water-resistant gypsum backer board in accordance with TCNA Handbook Method W245. Furnish waterproofing membrane at shower and bathtub walls.

2. Over interior concrete and masonry install in accordance with TCNA Handbook Method W202. Furnish waterproofing membrane at shower and bathtub walls.

3.4 INSTALLATION

A. At full mortar installations with bonded waterproofing membrane, apply cleavage membrane below mortar bed and waterproofing membrane above.

B. At full mortar installation where finish is indicated to slope, slope as indicated on Drawings and in no case greater than 1/4 inch per foot.

C. Install full mortar beds minimum 1-1/4 inches thick or as indicated on Drawings. Ensure proper alignment with adjacent floor finishes.

D. Lay ceramic tile to pattern indicated on Drawings. Do not interrupt tile pattern through openings. If floor pattern is not indicated on Drawings, lay out monolithic tile floors to minimize cut tiles along perimeter by more than one-half the tile width. Layout is subject to Architect's final approval.

E. Where large floor tile units will not conform to dished areas at floor drains, review floor lay out with Architect. Cut tiles on diagonal to facilitate conformance to slope. Final tile lay out around drain shall be symmetric.

F. Place thresholds, edge strips at exposed tile edges.

G. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor, base, and wall joints.

H. Place tile with joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

I. Form internal angles coved and external angles bullnosed. Use metal cove at all floor-to-wall intersections.

J. Install ceramic accessories rigidly in prepared openings.

K. Sound tile after setting. Replace hollow sounding units.

L. Keep expansion joints and divider strips free of adhesive or grout.

M. Allow tile to set for minimum of 48 hours prior to grouting.

N. Grout tile joints. Use specified grout type unless otherwise indicated.

O. Apply sanitary sealant as specified in Section 07 90 00 along junction of tile edge strip and dissimilar materials and junction of dissimilar planes.

3.5 CLEANING

A. Division 1 - Execution Requirements: Final cleaning.

B. Clean tile and grout surfaces.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Division 1 - Execution Requirements: Protecting installed construction.

B. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Work includes interior suspended and braced grid ceiling assemblies, with or without lay-in panels, including fascias and trim, as shown and specified.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 09 21 16 – Gypsum Board Assemblies: Specifications of expansion anchors and powder actuated fasteners. Suspended gypsum board ceilings.
3. Division 21 – Fire Suppression: Coordination of fire sprinklers.
4. Division 23 – Heating, Ventilating, and Air Conditioning: Coordination of air supply, ducts, and connections.
5. Division 26 – Electrical: Coordination of lighting fixtures and equipment outlet boxes.
6. Division 27 – Communications: Coordination of communications devices installation.
7. Division 28 – Electronic Safety and Security: Coordination of intrusion detection devices and fire detection and alarm devices.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM A641 - Standard Specification for Zinc–Coated (Galvanized) Carbon Steel Wire.
2. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
3. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
5. ASTM E580 Section 5 - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions (Seismic Design Category D, E & F).

B. Ceiling and Interior System Contractors Association (CISCA):

1. CISCA - Ceiling Systems Handbook.

C. California Department of General Services – Division of the State Architect (DSA):

1. DSA IR 25-2.13 – Metal Suspension Systems for Lay-In Panel Ceilings (2013 CBC).

1.3 PERFORMANCE REQUIREMENTS

A. Fire-Hazard Classification: Provide suspended panel ceiling systems that are identical to those tested for following fire hazard characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities have jurisdiction. Identify panel ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Test Method: ASTM E84.
2. Flame Spread: 25 or less.
3. Smoke Developed: 50 or less.

B. Grid Capacity: Deflection of installations shall not exceed a maximum of L/360 of span.

C. Acoustical-Type Tile Performance:

1. Light Reflectance: 85 percent minimum; manufacturer's standard white finish.
2. Noise Reduction Coefficient (NRC): 70 percent minimum.

1.4 SUBMITTALS

A. Submit the following items under provisions of Division 1.

B. Product Data: Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating specified requirements.

C. Shop Drawings: Indicate tile layout and related junctions with other work or ceiling finishes, splicing locations, changes in level, interrelation of mechanical and electrical and other items related to system and means of support of fixtures installed through ceiling panels.

D. Samples:

1. Exposed Suspension System Components: 12-inch long piece of each grid type specified in Part 3.
2. Ceiling Panels: Minimum 6 inch square, each type and finish specified in Part 3.

E. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.
2. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.

F. Provide documentation showing ceiling products have been tested in according to California Department of Public Health (CDPH) Standard Method v1.2–2017

1.5 QUALITY ASSURANCE

A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of AHJ.

C. Single-Source Responsibility: Obtain each type of ceiling system unit from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of Work.

D. Coordination of Work: Coordinate layout and installation of ceiling system units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition system.

E. Visual Mock-Up: Build portion of suspended ceiling as shown. Include lighting fixtures, air distribution system, drapery pocket, ceiling trim, and other items shown within bay.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver suspended ceiling units to Project site in original, unopened packages.

B. Storage and Protection: Store suspended ceiling units in fully enclosed space protected against damage from moisture, direct sunlight, surface contamination, and other causes.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Storage: Before installing suspended ceiling units, permit them to reach room temperature and stabilized moisture content.

B. Space Enclosure: Do not install suspended ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those expected for final occupancy.

1.8 MAINTENANCE

A. Extra Materials: Deliver 2 percent full-size units of each type of extra materials of amount installed to Owner at Project site. Furnish extra materials that match products installed, are packaged with protective covering for storage, and are identified with appropriate labels.

PART 2 – PRODUCTS

2.1 SUSPENDED PANEL CEILING SYSTEMS:

A. Manufacturers: Provide compliant products of one of the following or approved equal:

1. Armstrong World Industries, Incorporated.

2. United States Gypsum Corporation.

B. System Description: Wire-suspended ceiling grid system with or without lay-in panels of types scheduled in Part 3. Basis of Specification: Listed Components and Accessories are products of Armstrong World Industries.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish panel and grid materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

2.3 INTERIOR SYSTEM COMPONENTS

A. General: Provide each component as products of a single manufacturer. Material to contain 25-percent recycled content.

B. Suspension System Components: ASTM C635; ASTM E580, Section 5.1.

1. Grid: ASTM C635; classified Heavy Duty, hot-dipped galvanized. Double-web, rotary-stichted steel construction with 9/16 inch or 15/16 inch type exposed flange design, specific profiles as listed in Part 3 – Ceiling System Schedule.

a. All runners, splices, expansion devices and intersection connectors shall be designed to carry a mean ultimate test load of not less than 180 lbs in compression and tension per ASTM E580.

b. Finish: Manufacturer’s standard white; or match the actual color of the selected ceiling tile, unless noted otherwise.

2. Hanger Wires: ASTM A641; Class 1 galvanized steel; 12 gauge minimum and as indicated on Drawings, soft temper and 70 ksi minimum tensile strength.

3. Perimeter Moldings: Angle molding per Drawings, with matching corner caps and splice pieces; same finish and flange width as that of exposed suspension system members, 15-gauge with hemmed edge, typical.

4. Spreader Strut: Slotted angles or channels designed to snap tight to runners to prevent spreading.

C. Lateral Force Bracing Components:

1. Bracing Wires: ASTM C635; soft-annealed galvanized steel; 12 gauge minimum and as indicated on Drawings.

2. Compression Struts: C-studs as indicated on Drawings and specified in Section 09 21 16.

D. Ceiling Panels: ASTM E84; Class A. Refer to Part 3 – Ceiling System Schedule for Types.

2.5 ACCESSORIES

A. General: Provide manufacturer's standard miscellaneous items and accessories suitable for use intended and required for complete installation.

B. Runner End Detaining Clip: Integrate assembly with "Seismic Rx Suspension System, ICC Report ESR-1308" (Armstrong World Industries). Provide Armstrong's BERC2 clip, or equal, where grid is not attached to the wall.

C. Seismic Joint Clip: "SJCG" (Armstrong World Industries), or equal. Two piece unit designed to accommodate a seismic separation joint.

D. Main Beam Seismic Joint Clip: "SJMR15" (Armstrong World Industries), or equal.

E. Transition Fascias:

1. Straight Transition Fascia: Width as shown with 3/4 inch horizontal legs, straight sections with special bosses formed for attachment to tee-bar connection clip or hanging clip; commercial quality, extruded aluminum, factory-finished in factory-applied baked polyester paint to match tee-bar.

2. Manufacturer and Products: Armstrong World Industries, Inc.'s "Axiom Series Transition Channels".

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine substrates and structural framing to which ceiling system attached or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install suspended panel ceiling systems per DSA IR 25-2.13; ASTM E580, Section 5; ASTM C636; Drawings and manufacturer's instructions.

B. Ceiling Suspension System:

1. Main and Secondary Grid Members: Install at spacing indicated on Drawings, four foot maximum.

a. Suspend and brace grid with specified wires at indicated spacing.

C. Lateral Force Bracing:

1. Furnish compression strut at each splayed bracing wiring set. Do not install struts more than 1 in 6 out of plumb.

2. Powder-actuated devices are not permitted for attachment of bracing wires.

3. Bracing Omission:

a. Bracing may be omitted at small ceiling areas per the Referenced Standards.

b. Bracing may be omitted at free floating (“cloud”) ceilings not attached to any perimeter walls.

D. Acoustic-Type Ceiling Panels:

1. General: Make joints straight and true to line with exposed surfaces flush and level.

2. Cut panel edges to match tegular profile for partial panels having tegular edges.

3. Paint cut edges of panels with manufacturer’s standard white low-gloss paint, except edges within 1 inch of wall.

E. Metal and Wood Ceiling Panels: Provide positive attachment to ceiling runners when weight exceeds one-half psf.

F. Ceiling Fixtures, Air Terminals, and Other Devices:

1. Ceiling panels may not support any fixtures, terminals or devices.

2. Install devices in ceiling per Referenced Standards.

3.3 ERECTION TOLERANCES

A. Do not deviate from level in excess of 1/8 inch in 12 feet.

3.4 CLEANING

A. Cleaning: Clean exposed surfaces of ceiling tiles. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.5 CEILING SYSTEM SCHEDULE

A. Acoustic Panels (ACT1): Armstrong's "Ultima" Techzone No.1915 conforming to the following:

1. Size: 24 x 48 x 9/16 inches with 6" slots with fine textured finish.
2. Composition: Mineral fiber
3. Edge: Beveled tegular
4. Surface Color: White.
5. Ceiling Suspension: 9/16" Suprafine XL grid.

B. Acoustic Panels (ACT2): Armstrong's "ULTIMA Tegular" No.1912 conforming to the following:

1. Size: 24 x 24 x 3/4 inch with fine textured finish.
2. Composition: Mineral fiber
3. Edge: Tegular Lay-In
4. Surface Color: White.
5. Ceiling Suspension: 9/16" Suprafine XL grid.

C. Acoustic Panels (ACT3): Armstrong's "ULTIMA Tegular" No.1912 conforming to the following:

1. Size: 24 x 48 x 3/4 inch with fine textured finish.
2. Composition: Mineral fiber
3. Edge: Tegular Lay-In
4. Surface Color: White.
5. Ceiling Suspension: 9/16" Suprafine XL grid.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Un-perforated metal ceiling panels
2. Acoustical backing.
3. Suspension assemblies
4. Accessories; provide other necessary items including devices for attachment overhead construction, secondary members, splines, splices, connecting clips, wall connectors, wall angles, and other devices required for a complete installation.
5. Supplemental support framing: Provide fully engineered secondary framing as required to meet code, conforming to layout shown in drawings, to support direct-hung metal ceilings suspension system.
6. Coordinate layout and installation of items penetrating or being installed in ceiling systems with responsible trades.

B. Related Sections:

1. Sections 05 40 00 – Cold-Formed metal Framing
2. Sections 09 20 00 – Plaster and Gypsum Board
3. Sections 09 50 00 – Acoustical Ceilings
4. Sections 09 90 00 – Paintings and Coatings
5. Division 23 – Heating, Ventilating and Air Conditioning
6. Division 26 – Electrical

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. E 84 – “Standard Test Method for Surface Burning Characteristics of Building Materials”
2. E 488 – “Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements”
3. B 209 – “Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate”
4. C 423 – “Sound Absorption and Sound Absorption Coefficients by Reverberation Room Method”

5. E 580 – “Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint”
6. C 635 – “Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings”
7. C 636 – “Recommended Practice for Installation of Metal Ceiling Suspensions Systems for Acoustical and Lay-in Panels”
8. A 641 – “Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire”
9. A 653 – “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip process.
10. E 1264 – Classification for Acoustical Ceiling Products”
11. E 1477 – Standard Test Method for Luminous Reflectance factor of Acoustical Materials by use of Integrating-Sphere Reflectometers”
12. D 1044 – Practice for Abrasion Resistance
13. D 1002 – Practice for Adhesion Resistance

B. Architectural Woodworking Institute (AWI) and or WIC requirements shall be met for woodworking materials.

C. NEMA Standard 11-14-95 for Chemical Resistance

1.3 SUBMITTALS

A. Product Data: Manufacturers product data for each type of product specified in this section.

B. Product Certification: Manufacturer’s certifications that products comply with specified requirements and governing codes including product data, laboratory test reports and research reports showing compliance with specified standards.

C. Shop (Coordination) Drawings: Submit shop drawings for reflected ceiling plans (RCP’s), drawn to scale, and coordinating penetrations and ceiling mounted items. Show the following details:

1. Reflected ceiling plan including joint patterns & details.
2. Metal ceiling suspension system plan with appropriate components, suggested hanger locations & details.
3. Method of attaching suspension system hangers to building structure.
4. Ceiling-mounted items including: light fixtures, air outlets and inlets, speakers, sprinklers, and other interfaces.
5. Special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.

6. Framing and support details for work supported by ceiling suspension system.
7. List of materials, dimensions, hanger fastenings and any special details.
8. Minimum drawing scale: 1/8” = 1’-0”.
9. Provide full scale drawings of perforation patterns. Provide minimum 1”=1’-0” scale layout for each panel type showing perforation layout and orientation as required.

D. Samples for Verification: Full-size units (or as specified below) of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics. Submit samples for each type specified.

1. 12-inch square, (acoustical) metal pan units.
2. 12-inch long samples of each exposed molding or trim.
3. 12-inch long samples of each suspension component.

E. Qualification Data: For firms and persons specified in "Quality Assurance" (Section 1.5). Provide documents to demonstrate their capabilities and experience. Include lists of at least 5 completed projects with project names and addresses, names and addresses of Architects and employers, and other information specified.

F. Provide documentation showing ceiling products to meet LEED emissions requirements.

1.5 QUALITY ASSURANCE

A. Qualified Installer: Installer to have a minimum 5 years experience in the installation of specified materials on comparable projects. The firm shall have the approval of the mateials manufacturer.

B. Manufacturer

1. To certify a minimum of 5 years experience manufacturing similar products to those specified.
2. Provide support documentation including name and date of project completion. Include names and contact numbers of Architect and employers for reference
3. Manufacturer shall be single source and shall be the fabricator and supplier of appropriate major components.

C. Fire-Test-Response Characteristics: Provide acoustical metal pan ceilings that comply with one of the following requirements:

1. Fire-response tests performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.

2. Surface-burning characteristics of acoustical metal pan ceilings comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.

D. Mock-Ups: Before releasing acoustical metal ceilings, if requested, construct mock-ups for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following minimum requirements, using materials indicated for completed work:

1. Locate mock-ups in the location and of the size indicated or, if not indicated, as directed by the Architect. Minimum mock-up size to be 10'x 10' unless otherwise specified.

2. Notify Architect seven days in advance of the dates and times when mock-ups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

E. Pre-installation Conference: Conduct conference at Project site as directed by the project Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical metal ceiling units and suspension system components in original, unopened packages clearly labeled with the following information: name of manufacturing source and location; product type, description and quantity; clients name and shipping address.

B. Panel's protective layer to be removed only after installation is complete to help prevent panel surface damage.

C. Store components in a fully enclosed space where they will be protected against physical damage from direct moisture, significant change in humidity, direct sunlight, significant change in temperature, surface contamination, and any other preventable cause.

D. Exercise care in handling components to prevent damage to the surfaces and edges and prevent distortion or other physical damage. Comply with prescribed stacking instructions to prevent damage to thee components

1.7 PROJECT CONDITION

A. Space Enclosure: Do not install acoustical metal pan ceilings until after spaces are enclosed and weather tight and after wet work and work above ceilings is complete and accepted by project Architect.

B. 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. Allow materials to reach

ambient temperature and humidity for a minimum of 24 hours (48 hours recommended), prior to starting installation.

1.8 WARRANTY

A. Provide specified manufacturers warranty against defects in workmanship, discoloration, or other defect considered undesirable by the Architect or Owner.

B. This warranty shall remain in effect for a minimum period of five (5) years from date of initial acceptance.

1.9 MAINTENANCE & EXTRA MATERIALS

A. Maintenance Instructions: Provide manufacturers standard maintenance and cleaning instructions for finishes provided.

B. Extra Materials: Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Only typical system components are included with attic stock.

1. Acoustical Metal Ceiling Pan Units: Full-size units equal to 1½ percent (1½%) of amount installed.

2. Ceiling Suspension System Components: Quantity of each grid and exposed component equal to 1½ percent (1½%) of amount installed.

PART 2 – PRODUCTS

2.1 LINEAR METAL CEILING AND WALL SYSTEMS:

A. Manufacturer: Ceilings Plus - 6711 E. Washington Blvd., Los Angeles, CA 90040. 800-822-3411 – www.ceilingsplus.com.

B. Supply specified item or comply with Section 01 60 00 “Substitutions”. Specified manufacturer’s standard of quality and manufacturing tolerances shall be the criteria for evaluating “equivalent” products. Substitution shall be equal to or of better quality than the specified product in the opinion of the Architect and / or owner.

2.2 MATERIALS

A. Wall and Ceiling PL1 - Ceilings Plus “Planx” – Non-perforated – S-22 Oak Line Sarante.

1. Panels are to be manufactured from single sheets of aluminum selected for surface flatness, smoothness and freedom from surface blemishes where exposed to view in a finished unit. Do not use material where the exposed surface exhibit pitting, seam marks, roller marks, stains, discolorations, or variations in flatness exceeding those permitted by referenced standards for stretcher-leveled aluminum alloy sheets.

2. Panels to die formed with a +/-1” x .3” minimum integral returns on panel sides. No fasteners of any kind shall be visible on exposed face surfaces of ceiling

panels or support tees. Down light openings and other ceiling penetrations shall be factory precision cut whenever viable.

3. Panel material shall be primed aluminum sheet type 3105 (painted) / 5005 (anodized) series alloy that has a minimum 70% (50% @ 5005) recycled content. It shall be machine stretcher-leveled and a minimum of .040" thickness, or greater if required, so that the panel deflection does not exceed L/360.

4. The panel finish shall be:

   a. "Sarante" PVC free, faux wood veneer that is permanently bonded to the aluminum sheet with formaldehyde free, water based adhesive of minimum bond strength of 8 psi @ 25 degrees C.

5. Linear member sizes shall be 5 ½" unperforated face panels with ½" reveal – 6" module – 8'-0" typical lengths. 1'-2" x 8'-0" fascia panels (style white). Return panels, width varies x 9'-8" (style white)

6. End Profile: Panel end joints are butt condition with a splice plate (black), unless specified otherwise.

7. The plenum shall be 100% accessible.

8. Fire Tests: Complete system test including suspension, primed aluminum and finish shall meet ASTM E 84 Class A.

B. Provide and install "white" brakeshape finish trim on each side of each suspended area (or as specified).

2.3 METAL SUSPENSION SYSTEMS. GENERAL

A. Metal Suspension Standard: Provide panel manufacturer's metal suspension systems of types, structural classifications, materials, and finishes indicated that comply with applicable ASTM C 635 requirements.

1. Main and cross runners to be Standard "Heavy Duty" tee bar (as per ASTM C 635).

2. Face of main and cross runners to be factory finished matte black unless known otherwise.

3. Face of main runners to be slotted and factory formed to accept panel side flanges

4. Provide suspension system made from steel sheet with an average recycled content such that post-consumer recycled content plus one half or pre consumer content is not less than 25 percent.

B. Suspension Systems: Provide complete suspensions systems with main runners, cross runners, hangers, trim molding, seismic retention clips, load resisting struts and other suspension components required to support ceiling and other ceiling supported construction (some of these parts may be supplied by the installer).

C. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, "Direct-Hung", unless otherwise indicated (supplied by installer)

1. Provide anchor, for use in the particular application, as approved by the "Structural Engineer of record".

2. Structural substrate, as indicated to support attachment device, also to be approved by the "Structural Engineer of record".

3. Anchors specified must provide corrosion resistance as per metal type and application.

a. Anchors into Concrete (with or without steel deck)

i. Pre-installed – Cast in Place Anchors

ii. Post-installed - Expansion Anchors

iii. Post-installed – Chemical Anchors

iv. Post-installed – Powder Actuated Fasteners

4. "Direct-Hung" Suspension Systems: System composed of main runners supported by hangers to building structure, and complying with the following requirements:

a. Hangers: Type and metal standard with ceiling system manufacturer, sized to comply with structural classification indicated.

b. Wire Hangers, where applicable, Braces, and Ties: Provide wires complying with the following requirements

i. Zinc-Coated Carbon-Steel Wire: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper.

ii. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 2mm diameter.

iii. Extruded Aluminum members shall comply with ASTM B209.

c. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

d. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

e. Angle Hangers: Angles with legs not less than 22mm wide, formed with 1mm thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation, with bolted connections.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which acoustical metal panels attach or abut, with Installer present, for compliance with requirements specified in this and other

Sections that affect installation and anchorage, and other conditions affecting performance of metal panel ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

B. Measure each ceiling area and establish layout of acoustical metal pan units to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width units at borders, and comply with layout shown on reflected ceiling plans.

C. Survey substrate for wall attachment to assure squareness and proper elevation for wall panel installation.

3.3 INSTALLATION

A. General: Install acoustical metal pan ceilings, per manufacturers shop drawings provided, per manufacturer's written instructions and to comply with publications referenced below.

1. CISCA "Ceiling Systems Handbook.
2. Standard for Ceiling Suspension System Installations - ASTM C 636.
3. Standard for Ceiling Suspension Systems Requiring Seismic Restraint - ASTM E 580
4. IBC (International Building Code) standard for Seismic Zone for local area.

B. Suspend ceiling hangers from building's approved structural substrates and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produce hanger spacings that interfere with location of hangers at spacing required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Where used 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; that are

appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Space hangers not more than 48 inches on center, along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches from ends of each member. Supply supporting calculations from licensed Structural Engineer verifying hanger spacing meets all requirements, when spacing exceed those recommended.

6. Fine level grid to 1/8 inch in 10 feet from specified elevation(s), square and true.

7. Adjust suspension system runners so they are square (within .5 degree from 90 degrees) and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

C. Secure bracing wires to ceiling suspension members and to supports acceptable to Architect / Engineer and or inspector. Suspend bracing from building's structural members and / or structural deck, as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs(unless directed otherwise).

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pan. Method of edge trim attachment and design of edge trims to be approved by Architect.

1. Screw attach moldings to substrate at intervals not more than 18” O.C. and not more than 6” from ends, leveling with ceding suspension system to a tolerance of 1/8” in 10’. Miter corners accurately and connect securely.

2. Do not use exposed fasteners, including pop rivets, on moldings and trim without prior written approval. Or unless detailed otherwise.

E. Scribe and cut metal panel units for accurate fit at penetrations by electrical, fire sprinkler or other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

F. Install metal panel units in coordination with suspension system.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions, unless otherwise indicated. Install directionally patterned or textured panels in directions indicated on approved shop drawings. Panel-joints shall flow smoothly and in a straight line within 1/8” in 10’. Intersections shall be continuous

2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.

3. Remove protective film from panels only when space is completely clean and free of airborne particles. Use white cotton gloves for final installation of panels into grid system.

3.4 ADJUSTING AND CLEANING

A. Adjust ceiling components to provide a consistent finish and appearance in conformity with established tolerances and requirements.

B. Clean exposed surfaces of acoustical metal panel ceilings and walls. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Work Included: Finished suspended wood ceiling systems, complete, as shown and specified.

B. Work Specified Elsewhere:

1. Metal Fabrications: 05 50 00

2. Suspended Panel Ceiling System: 09 51 00

3. Painting and Coating: 09 90 00

4. Air Supply, Ducts, and Conections: Division 23

5. Light Fixtures: Division 26

1.2 QUALITY ASSURANCE

A. Installer Qualifications: The installer must be a firm with a minimum of two (2) years of successful experience in installation of suspended wood ceilings of similar requirements to this project. The installer must be acceptable to the architect, manufacturer, and owner's representative.

B. Environmental Standards: The wood ceiling shall originate from well managed forests as certified by accredited and recognized industry certifying organizations.

1.3 PROJECT CONDITIONS

A. Installation shall be done only when the temperature and humidity closely approximate the interior conditions that will exist when the building is occupied. The heating and cooling systems shall be operating before, during, and after installation, with the humidity of the interior spaces maintained between 25% and 55%, temperature between 60 to 90 degrees F.

B. It is important that plenums have proper ventilation, especially in high moisture areas. There shall be no excessive build up of heat in the ceiling areas.

C. Prior to the start of installation, all exterior windows and doors are to be in place, glazed, and weather-stripped. The roof is to be watertight, and all wet trades' work is to be completed, and thoroughly dry.

D. Mechanical, electrical, and other utility service installations above the ceiling plane shall have been completed. No materials should rest against, or wrap around, the ceiling suspension components or connecting hangers.

1.4 SUBMITTALS

A. Product Data: Submit product data sheets and installation instructions for all supplied ceiling materials.

B. Shop Drawings: Submit shop drawings showing Panel Grille lengths, and placement of hangers, T-rail carriers, and other details needed to show proper installation. Show locations for linear wood grille access panels.

C. Samples: Submit 12" (305mm) wide x 12" (305mm) long wood ceiling sample, in the specified Panel Grille style, with finish applied.

D. Provide documentation showing ceiling products to meet LEED emissions requirements

1.5 DELIVERY, STORAGE, AND HANDLING

A. Panel Grilles and components shall be delivered to the project site in original, unopened packages.

B. The Panel Grilles shall be stored flat and level in a fully enclosed space. For a minimum of seventy-two (72) hours immediately prior to ceiling installation, the Panel Grilles shall be stored in the room in which they will be installed. The temperature and humidity of the room shall closely approximate those conditions that will exist when the building is occupied. The Panel Grilles must be stored off the floor.

C. Care in handling must be exercised to avoid damage.

1.6 WARRANTIES

A. Manufacturer: All materials supplied by the ceiling manufacturer shall be guaranteed against manufacturing defects for one (1) year.

B. Contractor: All work shall be guaranteed for one (1) year from the date of Substantial Completion of the work.

PART 2 – PRODUCT

2.1 LINEAR WOOD PANELS

A. The wood strips shall be made from prime grade, all-natural White Birch with a transparent stained finish, RC Satin Clear Blend. Provide assembly from Rulon International, or equal.

B. Panelized Linear Wood Panels, (ALW1) are assembled from boards using 4 ½” modules, having wood strips ¾” thick X 3-3/4” wide with a ¾” ABS spacers between the boards. A fiberfelt spacer shall be factory-installed between the wood strips. The fiberfelt spacer is provided in a standard black color.

C. Standard Panel Grilles shall be assembled 1' wide - in nominal lengths of 2’ to 10’. Wood strips shall be manufactured without finger-joints, and fastened together with wood backers on reverse side (upside). The battens shall be positioned 5-1/2” from the ends and 12" on center, for support of the system. Woodbackers shall be painted black.

D. Woodbacker clips shall be used to suspend Linear Wood Panels when removability of panels is necessary for access above the ceiling.

E. All dimension tolerances are ± 1/8".

F. Manufacturer: Wood strip panel grilles: Rulon International or equal.

2.2 SUSPENSION SYSTEMS

A. Panel Grilles shall be suspended from suspended standard heavy-duty 15/16" Tee-rail carriers provided and installed under Specification Section 09 51 00. Coordinate tee-rail suspension system location with panel grille layout if installed by separate contractor. Provide suspension grid in flat black color.

B. Suspend Panel Grilles using manufacturer’s methods for connection so removability of panel grilles, where shown, is possible for access above the ceiling.

2.3 ACCESSORIES, EDGES, BORDERS, AND PERIMETER TRIMS

A. Edges, borders, and perimeter trims, shall as shown in the drawings. All wood ceiling products specified shall be supplied by the ceiling manufacturer.

B. Panel Grille black-out scrim: Anchorage 2335 by Guilford of Maine or equal recommended by panel grille system manufacturer.

1. Color: Black polyester fabric.

2. Weight: 15.0 +/- 1.0 oz/liny d.

3. Width 66” minimum useable.

C. Acoustic Insulation: 2” thick batt insulation with black facing.

2.4 FINISHES AND COLORS

A. All Panel Grilles shall be factory-finished with RC Satin Clear Blend.

B Finishes shall be stain or sealer coats, spray-applied to a smooth-sanded surface.

PART 3 – EXECUTION

3.1 PREPARATION

A. Ceiling Layout: The contractor shall measure ceiling areas, and establish layout of Panel Grilles and T-rails, in accordance with installation instructions.

B. Coordination:

1. The contractor shall furnish the layout for supports that shall be installed for suspension of ceilings.

2. Furnish concrete inserts, steel deck hanger clips, or similar devices for installation and in time to coordinate the work.

3. The contractor shall coordinate with the work of other trades the location of devices which will penetrate the Panel Grilles or interfere with the installation. Recessed or surface devices located within the ceiling panels are to be located and cut in the field. This includes but is not limited to light fixtures, HVAC equipment, and fire suppression system components.

3.2 INSTALLATION

A. General: The contractor shall install materials in accordance with manufacturers printed instructions. The installation shall comply with all applicable Codes, regulations and industry standards.

B. Perimeters: Using a leveling device, the contractor shall lay out and install the perimeter trim as specified.

C. Suspension: The T-rail carriers shall be suspended and leveled in a direction perpendicular to the wooden strip direction. #12 gauge wire hangers shall be used to support T-rail carriers. Hangers shall be placed at 4' intervals along the carrier.

D. Black-out scrim: Install fabric to suspension grid as recommended by Panel Grille manufacturer. Lay out fabric to minimize joints. Joints should overlap a minimum 3” to prevent open joints.

E. Wood Suspension: Panel Grilles shall be suspended from the T-rail carrier system by dowel clips. Install Panel Grille wood slats in alignment.

F. Install acoustical insulation above suspension system as Panel Grilles are being installed and as recommended by Panel Grille manufacturer.

3.3 ADJUSTMENT, CLEANING, AND REPAIR

A. The contractor shall make final adjustments to level or contours.

B. Upon completion of ceiling installation, all Panel Grilles and borders shall be cleaned free of dirt, dust, grease, oils, and fingerprints.

C. All work which cannot be successfully cleaned or repaired, shall be removed and replaced.

3.4 INSPECTION

A. Upon completion of ceiling installation, the owner's representative shall inspect all finished surfaces to ensure that work has been performed in a manner satisfactory to the owner. Any deficiencies in the installed ceiling shall be corrected by the contractor at no additional cost to the owner, or to the ceiling manufacturer.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes resilient flooring, resilient wall base, and accessories.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 07 26 20 – Concrete Vapor Emission Control: Includes attendance at concrete vapor emission control pre-installation meeting; leveling of concrete floor surfaces.
3. Section 07 90 00 – Joint Protection: Sealants.
4. Section 09 68 13 – Tile Carpeting: Use of resilient base.
5. Section 09 68 16 – Sheet Carpeting: Use of resilient base.

1.2 References

A. American Society for Testing and Materials International (ASTM):

1. ASTM D2047 – Standard Test Method for Static Coefficient of Friction.
2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
3. ASTM E648 - Test Method for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.
4. ASTM F1861 - Specification for Resilient Wall Base.
5. ASTM F2034 – Standard Specification for Linoleum Sheet Flooring.

B. National Fire Protection Association:

1. NFPA 253: Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

C. South Coast Air Quality Management District (SCAQMD):

1. SCAQMD Rule 1168: Adhesive and Sealant Applications.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate seaming plan, custom patterns and inlay designs.

C. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

D. Samples:

1. Submit manufacturer's complete set of color samples for initial selection.

2. Submit two samples, 20 x 20 inch in size illustrating color and pattern for each resilient flooring product specified.

E. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Indoor Environmental Quality Certificates: Certify volatile organic compound content for each interior flooring system and adhesive.

F. Provide product documentation that ensures all flooring meets LEED VOC emissions requirements

1.4 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning and polishing.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Product storage and handling requirements.

B. Protect roll materials from damage by storing on end.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Division 1 - Product Requirements.

B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

C. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.8 MAINTENANCE MATERIAL

A. Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish 5 percent of flooring of each type and color specified.

PART 2 – PRODUCTS

2.1 RESILIENT FLOORING

A. Resilient Sheet Type “RF1”: ASTM F2034, Type I; PVC-free; homogenous sheet linoleum with natural jute backing and welded seams. Forbo Flooring Systems’ “Marmoleum”.

1. Critical Radiant Flux: ASTM E648, Class 1.
2. Thickness: 1/8 inch nominal (2.5 mm).
3. Minimum Roll Width: 78 inches.
4. Seam Rod: Manufacturer’s matching.
5. Coefficient of Friction: ASTM D2047; 0.6 or greater wet and dry.
6. Color: As indicated on drawings.

2.2 RESILIENT BASE

A. Manufacturers: Furnish compliant products of one of the following or approved equal:

1. Allstate Rubber.
2. Burke Flooring.
3. Johnsonite / Tarkett.

B. Product Description: ASTM F1861; ASTM E84, Class C or better, PVC-free rubber wall base and manufacturer’s recommended low-VOC adhesive. Basis of Specification: Products of Johnsonite are listed below.

C. Resilient Base Types:

1. Resilient Base Type “RB1”: Type TS, Group 1, Styles A. 4-1/2 inches high with standard profile: Johnsonite “Tightlock” series. Color: As indicated on drawings. Use coved style at exposed concrete and straight style at carpet tile.

2.3 SELF-COVED BASE

A. Manufacturer: Same as specified resilient flooring.

B. Height: 4 inches unless indicated otherwise on Drawings.

2.4 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Indoor Environmental Quality Characteristics:

1. Adhesives and Sealants: Maximum volatile organic compound content in accordance with Section 01 81 13.

2.5 ACCESSORIES

A. Adhesives: Recommended by flooring manufacturer. VOC Limit: 60 g/L.

B. Transitions Accessories: Adhered vinyl, disabled access-compliant profiles.

1. Resilient Flooring Reducer: Underslung type, 1-5/8 inch maximum exposed width. Mercer No. 735 or equal.

C. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Verification of existing conditions before starting work.

B. Section 07 26 20 – Concrete Vapor Emission Control: Furnish at all new concrete slabs scheduled to receive resilient flooring. Verify that existing concrete floors meet maximum vapor emission rates required by resilient flooring manufacturer for warranty of flooring and installation, and exhibit negative alkalinity, carbonization, and dusting. Furnish emission control system at existing concrete floors that do not meet the required rates.

C. Verify floor and lower wall surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.

3.2 PREPARATION

A. Smooth and level concrete floor surfaces that are out of tolerance per Section 07 26 20.

B. Prohibit traffic until filler is cured.

C. Clean substrate.

D. Apply primer as required to prevent "bleed-thru" or interference with adhesion by substances cannot be removed.

3.3 EXISTING WORK

A. Extend existing resilient flooring installations using materials and methods compatible with existing installations, or as specified.

3.4 INSTALLATION - GENERAL

A. Install flooring in accordance with manufacturer's printed instructions.

B. Installed flooring shall be fully bonded to substrate, free from damage, flaws, or other defects detrimental to appearance, uniform in pattern, spacing, margin, and finish.

C. Spread adhesive evenly in quantity recommended by flooring manufacturer to ensure adhesion uniformly over the entire area of installation.

D. Avoid applying excessive amount of adhesive to sub-floor. Bleeding of adhesive on finished floor requires removal of flooring and adhesive and re-laying of flooring at no expense to Owner.

E. Where adhesives with a limited "pot life" are used, install flooring within allowable time limit.

3.5 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams in accordance to seaming plan or as directed by Architect. Align joints and seams parallel to building lines to produce symmetrical pattern as appropriate.

1. Lay sheets in same direction.

B. Lay flooring with tight and straight joints, level and true, free from waves, blisters, buckles, cracks, projecting edges, or other imperfections.

C. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

D. Heat Welded Seams: Join flooring with heat welded seams.

1. General procedures consist of routing flooring for joint, position welding rod of proper size into routed space, and thermally fusing rod to flooring material to form homogeneous and seamless floor.

2. Use equipment and procedures developed by flooring manufacturer.

3. Fuse welding rod and flooring at least 65-percent through thickness of material.

4. Remove excess welding rod material upon completion of welding. Finished surface across joint shall be flush, free from recessed or raised areas.

5. Correct un-welded seams at no extra expense to Owner.

E. Self-Coved Base: Terminate flooring with integral coved base to walls, columns, cabinets, and other construction.

1. Use coved base filler as backing at floor to wall junction.

2. Extend sheet flooring vertically to height indicated.

3. Cover top edge with cap strip.

F. Roll finished flooring with minimum 150-pounds roller, in each direction to insure solid contact between flooring and sub-floor, free from air pockets, bulges, low and high corners or edges.

3.5 INSTALLATION - TILE FLOORING

A. Install tile in direction indicated. To degree possible, install in consistent direction in adjacent rooms.

B. Fully-butt tiles by setting into place without sliding. Hand roll all seams immediately.

C. Roll entire floor or sections of floor per manufacturer's instructions. Do not exceed rolling time constraints relative to adhesive set.

3.6 INSTALLATION – RUBBER BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use pre-molded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove excess adhesive from floor, base, and wall surfaces without damage.

C. Clean, seal, and maintain resilient flooring products.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Division 1 - Execution and Closeout Requirements: Protecting installed construction.

B. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes fluid-applied epoxy resin system flooring with self-coved base, including:

1. Preparation of existing concrete substrate.
2. Waterproofing membranes and accessories.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 03 30 00 - Cast-In-Place Concrete: Concrete subfloor finish.
3. Section 07 26 20 – Concrete Vapor Emission Control: Includes attendance at concrete vapor emission control pre-installation meeting; leveling of concrete floor surfaces.
4. Section 07 90 00 - Joint Protection.

1.2 REFERENCES

A. ASTM International:

1. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
2. ASTM C413 - Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
3. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
3. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
5. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
6. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

1.3 PERFORMANCE REQUIREMENTS

A. Flammability: ASTM D635, self-extinguishing when bonded to concrete.

B. Slip Resistance: Material shall be hard, firm and slip resistant.

C. VOC Content: 50 g/L maximum.

D. Tensile Strength: ASTM C307, 1,800 psi minimum.

E. Compressive Strength (Aggregate Included): ASTM C579, 10,000 psi minimum after seven days.

F. Impact Resistance: ASTM D2794, >160 in/lbs; or ASTM D2240 Shore D, 80-85.

G. Water Absorption: ASTM C413, < 1 percent.

H. Abrasion Resistance: ASTM D4060 (CS17), 0.06 gm maximum weight loss.

1.4 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.

C. Samples: Each material, type of color and mix specified, three samples of 12-inches square, in thicknesses of respective film layers. Accepted samples shall be used as standard of color chips exposure and finish.

D. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

E. Qualifications: Submit Installer’s project lists and specified manufacturer certifications, including project names and addresses and contact names and telephone numbers.

1.5 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years’ experience.

B. Installer: Company specializing in performing work of this section with minimum three years’ documented experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Product storage and handling requirements.

B. Materials shall be delivered to Project site in supplier's original wrappings and containers, labeled with source or manufacturer's name, material or product brand name, and lot number if any.

C. Materials shall be stored in their original, undamaged packages and containers, in a dry, secure location where they will not be exposed to direct sunlight.

D. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 1 - Product Requirements.

B. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

1.9 MAINTENANCE MATERIAL

A. Division 1 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Extra Stock Materials: Supply two (2) gallons of flooring material, of each color selected.

PART 2 – PRODUCTS

2.1 RESINOUS FLOORING

A. Manufacturer: Furnish compliant products of one of the following or approved equal:

1. Dex-O-Tex / Crossfield Products Group.
2. Dudick, Incorporated.
3. Stonhard, Incorporated.

B. Product Description: Multiple-component, 3/16 inch thick, waterproof, self-coved flooring system comprised of a troweled epoxy resin mortar base, free-flowing epoxy under- or grout coat, quartz aggregate and UV-resistant clear epoxy sealer. Basis of Specification: Stonhard's "Stonshield HRI".

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

C. Indoor Environmental Quality Characteristics:

1. Adhesives and Sealants: Maximum volatile organic compound content in accordance with Section 01 81 13.

2.3 COMPONENTS

A. Primer: Manufacturer's recommended bondcoat.

B. Troweled Epoxy Base: Multiple-component mortar consisting of epoxy resin and curing agent.

C. Under (Grout) Coat: Free flowing formulation consisting of epoxy resin and curing agent.

D. Aggregate: Colored quartz.

E. Sealer: Two-component, UV-resistant clear epoxy.

F. Matrix Color: As indicated on Drawings.

2.4 ACCESSORIES

A. Waterproofing Membrane: Type recommended or produced by manufacturer of resinous flooring system for type of service and floor condition indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Coordination and project conditions.

B. Verify floor surfaces are smooth and flat with maximum variation as specified in Section 03 30 00 and are ready to receive work.

C. When manufacturer requires limitations of concrete subfloor vapor emission and alkalinity, furnish Concrete Vapor Emission Control per Section 07 26 20. Test concrete subfloor as specified to verify performance after installation of control.

D. Verify floor and lower wall surfaces are free of substances capable of impairing adhesion of adhesive and finish materials.

3.2 PREPARATION

A. Prepare surfaces as required by manufacturer.

B. Smooth and level concrete floor surfaces that are out of tolerance per Section 07 26 20.

C. Concrete substrate shall be clean and dry. Dislodge dirt, mortar spatter, paint overspray, and other dry surface accumulations and contamination by bead-blasting, scraping, brushing, sweeping, vacuuming, and/or compressed air blow-down.

D. Surfaces that are heavily contaminated shall be cleaned with appropriate degreaser, detergent, or other appropriate cleaner/surfactant followed by thoroughly rinsing with

fresh water to remove accumulation prior to mechanical cleaning efforts. Mechanical cleaning will not remove such deposits, but only drive them deeper.

E. Install transition/termination strips along flooring edge and along top edge of cove base, and other locations as required by flooring manufacturer.

F. Install fillet strips at base of walls where flooring is to be extended up wall as a base.

3.3 INSTALLATION

A. Apply flooring system in accordance with manufacturer's printed instructions.

B. Prime subfloor in accordance with manufacturer's recommendations.

C. Furnish waterproofing membrane per manufacturer's directions at floor locations on elevated decks only.

C. Apply each component of flooring system within thickness range required by manufacturer, to achieve total system thickness of 3/16 inch:

D. Cove system at vertical surfaces as shown on Drawings, or 4 inches high if not shown.

E. Work in quick and deliberate pace to avoid deterioration of material from manufacturer's stated pot life.

F. Do not leave any puddles. Roll out such accumulations.

G. Allow adequate curing time between each coat.

H. When broadcasting decorative aggregate, apply evenly and consistently, including at cove base.

3.4 PROTECTION

A. Division 1 - Execution and Closeout Requirements: Protecting installed construction.

B. Prohibit traffic on floor finish per manufacturer's directions, until cured.

C. Protect flooring from traffic with protective material until Substantial Completion.

3.5 CLEANING

A. Cleaning: Wash flooring with manufacturer's recommended cleaning compound. Use warm water and fine abrasive where necessary to remove stains. Rinse with clean water and allow surface to dry thoroughly.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes carpet tile, fully adhered, and accessories.

B. Related Requirements:

1. Section 07 26 20 – Concrete Vapor Emission Control.
2. Section 09 65 00 – Resilient Flooring: Base finish.
3. Divisions 26 and 27 – Electrical and Communications: Electrical and telecommunications floor cover plates for carpeted floor finish.
4. Section 01 81 13 Sustainable Design Requirements.

1.2 REFERENCES

A. American Association of Textile Chemists and Colorists:

1. AATCC Test Method 134 - Electrostatic Propensity of Carpets.

B. ASTM International:

1. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
2. ASTM E662 – Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

C. Carpet and Rug Institute:

1. CRI Carpet Installation Standard - Standard for Installation of Commercial Carpet.
2. CRI Green Label Plus Testing Program.
3. CRI Model Specifications for Commercial Carpets.

D. National Fire Protection Association:

1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

E. South Coast Air Quality Management District:

1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples:

1. Submit full carpet tiles illustrating color and pattern design for each carpet color selected. Matching roll carpet samples if applicable.

2. Submit 6 inch long samples of edge strip.

D. Provide product documentation that ensures all flooring meets LEED VOC emissions requirements

1.4 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.5 QUALITY ASSURANCE

A. Surface Burning Characteristics:

1. Floor Finishes: Comply with one of the following:

a. Critical Radiant Flux: ASTM E648, compliant; and NFPA 253, Class I, minimum 0.45 watts/sq cm.

b. Specific Optical Density Smoke Rating: ASTM E662; 450 or less.

B. Texture Appearance Retention Rating: Rating classifications as determined by CRI Model Specifications for Commercial Carpets.

1. Greater than or equal to 3.0 TARR for Heavy Traffic Level Classification.

C. Static Control: AATCC-134; 3.5 KV or less under standard test conditions of 70 degrees Fahrenheit and 20 percent relative humidity.

D. Indoor Environmental Quality Characteristics

1. Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

2. Carpet: Maximum volatile organic compound content in accordance with CRI Green Label Plus Testing Program.

1.6 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. FCIB or IFCI certified carpet installers.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Division 1 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.

B. Store materials in area of installation for 48 hours prior to installation.

1.8 MAINTENANCE MATERIAL

A. Division 1 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Extra Stock Materials:

1. Furnish additional five percent of installed carpet tile quantity of each color and pattern selected. Wrap, label with carpet type, pattern, and color, and store as directed by Owner.

PART 2 – PRODUCTS

2.1 CARPET TILE

A. Manufacturers:

1. As indicated on drawings.

2. Substitutions: Not Permitted.

2.2 COMPONENTS

A. Carpet Type CPT-1: As indicated on drawings.

1. Color: As indicated on drawings.

2. Tile Size: 24 x 24 inch, nominal.

3. Construction: Textured Loop.

4. Gauge: 1/10.

5. Stitches per Inch: 10 or more.

6. Pile Height: 0.100 – 0.120 inches.

7. Average Density: 6,900 or more.

8. Fiber: Invista Antron Legacy Type 6,6 nylon.

9. Pile Weight: 20 oz/sq yd.

10. Primary Backing Material: 100% woven synthetic.

2.3 ACCESSORIES

A. Reducer Edge Strips: Adhered vinyl, disabled access-compliant profile, 1-1/2" exposed width, color as selected by Architect. Mercer's "No. 800" or equal.

B. Adhesive: Recommended by carpet manufacturer, pressure-sensitive, water-resistant type.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Verification of existing conditions before starting work.

B. Prior to start of Work, examine surfaces to receive carpet and verify that surfaces are clean, dry, sound, level and free of oil, grease, wax, and other foreign matter that would impair installation. Do not start Work until unsatisfactory conditions are corrected.

C. Section 07 26 20 – Concrete Vapor Emission Control: Furnish at all new concrete slabs scheduled to receive resilient flooring. Verify that existing concrete floors meet maximum vapor emission rates required by resilient flooring manufacturer for warranty of flooring and installation, and exhibit negative alkalinity, carbonization, and dusting. Furnish emission control system at existing concrete floors that do not meet the required rates.

D. Matching: Check matching of carpet before cutting and ensure there is no visible variation between dye lots.

3.2 PREPARATION

A. Division 1 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Smooth and level concrete floor surfaces that are out of tolerance per Section 07 26 20.

C. Clean substrate.

D. Apply primer as required to prevent interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION

A. Install carpet tile in accordance with CRI Carpet Installation Standard and manufacturer's recommendations.

B. Do not mix carpet from different cartons unless from same dye lot.

C. Cut carpet tile clean, straight and unfrayed. Fit carpet tight to intersection with vertical surfaces without gaps.

D. Install carpet tile in square pattern, with pile direction relative to next unit and building orientation per Architect's direction or specified in Part 2. Do not change run of pile in any one room or from one room to next. Locate change of color or pattern between rooms under door centerlines.

E. Fully adhere carpet tile to substrate, free from damage, flaws, or other defects detrimental to appearance, uniform in pattern, spacing, margin, and finish

F. Adhere carpet tile with self-stick adhesive backing by removing protective membrane and pressing tile back onto clean and dry substrate.

G. Trim carpet tile neatly at walls and around interruptions. Where no base is scheduled, fit carpet snugly, leaving no gaps.

H. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. Use full-length pieces only. Butt tight to vertical surfaces. Where splicing cannot be avoided, butt ends tight and flush.

3.4 CLEANING

A. Division 1 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove excess adhesive from floor, base, and wall surfaces without damage.

C. Clean and vacuum carpet surfaces.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes decorative, noise-reducing panels for fixed installation on walls.

B. Related Sections:

1. Section 01 81 13 - Sustainable Design Requirements.

2. Section 09 21 16 - Gypsum Board Assemblies: Provision of wall backing and gypsum board finishing.

1.2 REFERENCES

A. ASTM International:

1. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

2. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.

4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Division 1- Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate layout and dimensions of sound-absorptive wall panels, means of attachment and interface with adjacent materials.

C. Product Data: Include composition of material, performance metrics and statement of VOC content.

D. Samples: Submit two samples, minimum 6”x6”, of each component illustrating construction, profile and surface texture and finish.

1.4 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Submit surface care and maintenance procedures.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years’ experience.

B. Surface Burning Characteristics: ASTM E84, Class A, maximum 25/450 flame spread/smoke developed index.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in manufacturer's original packaging. Inspect for damage.

C. Store materials indoors with environmental conditions as specified for installation.

D. Acclimate materials to installation conditions for seventy two hours prior to installation.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Division 1 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install acoustical wall treatment until space has been enclosed and is watertight, wet work is complete and dry and adjacent and related work is completed.

C. Do not install acoustical wall until ambient temperature and humidity level will be continuously maintained at conditions indicated for Owner occupancy.

1.8 EXTRA MATERIALS

A. Division 1 - Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish five percent of additional panel stock, and minimum five panels.

1.9 WARRANTY

A. Material: Warrant panels to remain colorfast and free of embrittlement for a period of two years from date of substantial completion.

PART 2 – PRODUCTS

2.1 FIXED SOUND-ABSORPTIVE PANELS

A. Manufacturers: Furnish the following product. No exceptions permitted.

1. Kirei USA LLC's "EchoPanel Print Panels"

B. Product Description: ASTM E84 Class A, thermoplastic polymer resin (PET) panels with flat profile.

1. Noise Reduction Coefficient (NRC): ASTM C423, 0.25 minimum.

2. Panel Size: 4 foot x 8 foot minimum nominal dimension.
3. Panel Thickness: 12mm.
4. Mounting: Non-resin adhesive.
5. Color: Printed pattern, to be selected by Architect from manufacturer's standard.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Indoor Environmental Quality Characteristics:

1. Adhesives and Sealants: Maximum volatile organic compound content in accordance with Section 01 81 13.

2.3 ACCESSORIES

A. Manufacturer's recommended, standard, VOC-compliant, non-resin adhesive.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify substrate is flat, plumb and level and ready to receive the work of this section.

C. Verify adjacent and related work is complete.

3.2 PREPARATION

A. Establish distribution of panels across each wall to ensure a symmetric layout with respect to perimeter as well as other objects on wall.

3.3 INSTALLATION

A. Install frame plumb, level, in plane, and aligned.

B. Attach panels to wall with adhesive in accordance with manufacturer's instructions.

C. Use included internal splines, and J-moldings as furnished for panel edges.

D. Material is eligible for standard PET recycling streams. Dispose of clean, excess material by recycling in accordance with Section 01 74 19 – Construction Waste Management.

3.4 ERECTION TOLERANCES

A. Division 1 - Quality Requirements: Tolerances.

B. Maximum Variation From Indicated Position: 1/4 inch.

C. Maximum Offset From Indicated Alignment: 1/16 inch.

D. Maximum Out of Square: 1/8 inch difference in panel diagonals.

3.5 ADJUSTING AND CLEANING

A. Division 1 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean exposed fabric faces.

C. Replace stained, damaged and broken panels.

D. Protect sound-absorptive panels from abuse and overspray of other materials for duration of construction.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Work includes sound-absorbing, suspended, decorative acoustical ceiling devices, including framing hardware and fasteners.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 05 50 00 – Metal Fabrications: Provision of miscellaneous mounting shapes and hardware.
3. Section 09 21 16 – Gypsum Board Assemblies: Specifications of expansion anchors and powder actuated fasteners.
4. Division 21 – Fire Suppression: Coordination of fire sprinklers with baffle locations.
5. Division 23 – Heating, Ventilating, and Air Conditioning: Coordination of air supply, ducts, and connections with baffle locations.
6. Division 26 – Electrical: Coordination of lighting fixtures and equipment outlet boxes with baffle locations.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM C423 – Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 PERFORMANCE REQUIREMENTS

A. Fire-Hazard Classification: Provide acoustical ceiling baffles that meet the following fire hazard characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities have jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Test Method: ASTM E84.
2. Flame Spread: 25 or less.
3. Smoke Developed: 50 or less.

1.4 SUBMITTALS

A. Submit the following items under provisions of Division 1.

B. Product Data: Submit manufacturer's technical data and installation instructions for each type of ceiling baffle required.

C. Shop Drawings: Indicate ceiling baffle layout and details. Show changes in level, interrelation of mechanical and electrical and other items related to system and means of support of fixtures requiring coordination with baffles.

D. Samples: Baffle Panels. Minimum 6 inch square, each type and finish specified.

E. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.

2. Product Cost Data: Products with recycled material content. Exclude cost of labor and equipment to install products.

1.5 QUALITY ASSURANCE

A. Qualified Installer: Installer to have 3 years' experience in the installation of specified material type on comparable projects.

B. Single-Source Responsibility: Obtain all ceiling baffle components from single source.

C. Coordination of Work: Coordinate layout and installation of acoustical ceiling baffles and suspension system components with other overhead construction, including light fixtures, HVAC equipment, fire-suppression system components, and partition systems.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver acoustical ceiling baffles to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes. All nearby wet work, including concrete and plastering, must be complete and dry.

B. Handle ceiling baffles and dowels carefully to avoid damaging the surface and edges in any way.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Storage: Before installing acoustical ceiling baffles, permit them to reach room temperature and a stabilized moisture content.

B. Space Enclosure: Do not install acoustical ceiling baffles until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those expected for final occupancy.

1.8 EXTRA MATERIALS

A. Division 1 - Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish five percent of additional panel stock, and minimum five baffle panels.

1.9 WARRANTY

A. Material: Warrant baffles to remain colorfast and free of embrittlement for a period of two years from date of substantial completion.

PART 2 – PRODUCTS

2.1 ACOUSTICAL CEILING BAFFLES:

A. Manufacturers: Provide compliant products of the following or approved equal (no known equal):

1. Kirei USA, LLC.

B. System Description: ASTM E84 Class A, lightweight, geometric panels with majority composition of thermoplastic polymer resin (PET), each unit mounted on two dowels and suspended with stainless steel aircraft cable. Basis of Specification: Kirei USA's "EchoCloud Ziggy".

1. Noise Reduction Coefficient (NRC): ASTM C423, 0.25 minimum.
2. Panel Size: Custom width and lengths as indicated, up to maximum panel size of 46 inchs x 72 inches
3. Panel Thickness: 12mm.
4. Geometric Depth: 4 inches.
5. Weight: Less than 1 lb/sf and 18 lbs for maximum panel size.
6. Mounting Dowels: Manufacturer's standard 3/4-inch diameter, unfinished White Birch to be field finished as indicated under Part 3 – Execution.
7. Baffle Color: Solid color, to be selected by Architect from manufacturer's standard.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish baffle materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

C. Indoor Environmental Quality Characteristics:

1. Adhesives and Sealants: Maximum volatile organic compound content in accordance with Section 01 81 13.

2.3 ACCESSORIES

A. Suspension Cable: 3/64” stainless steel aircraft cable, looped.

B. Terminal Hardware: Manufacturer’s standard hardware for connecting aircraft cable to baffle dowels.

C. Deck Anchorage: As shown on Drawings and specified in Sections 05 50 00 and 09 21 16.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine substrates and structure to which ceiling baffles will suspend from. Ensure unencumbered access to structure overhead. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Field finish wood dowels to match white birch benches specified elsewhere.

3.3 INSTALLATION

A. General: Install ceiling baffle systems as shown and per manufacturer’s instructions. Install terminal hardware to dowels, and install four suspension cables for each baffle panel.

B. Anchor suspension cables to structure above using powder-actuated hardware devices utilized for suspension wires for suspended gypsum board ceilings.

C. Set Work accurately into position, plumb, level, true, and free from rack. Anchor firmly into position as shown, using four suspension cables for each baffle panel.

D. Do not wrap or bend suspension cable around other objects. Do not use cables and ceiling baffles to support any other material.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Indicated Position: 1/4 inch.

B. Maximum Variation from Plumb: 1/4 inch.

3.5 CLEANING

A. Division 1 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean exposed fabric faces.

C. Replace stained, damaged and broken baffles and dowels.

D. Protect acoustical ceiling baffles from abuse and overspray of other materials for duration of construction.

END OF SECTION

Part 1 – GENERAL

1.1 SUMMARY

A. Section includes surface preparation and field application of paints, other coatings. "Paint" is defined as any coating system herein specified.

B. Related Sections:

1. Section 01 81 13 – Sustainability Requirements.
2. Section 05 50 00 – Metal Fabrications: Shop primed items.
3. Section 05 70 00 – Decorative Metal: Shop primed and finished items.
4. Section 08 12 14 – Standard Steel Frames: Shop primed items.
5. Section 08 14 16 – Flush Wood Doors: Shop stained wood doors.
6. Section 08 31 13 – Access Doors and Panels: Shop primed access doors.
7. Section 09 21 16 - Gypsum Board Assemblies: Joint compound skim coat finish.
8. Divisions 22 through 23 - Shop primed plumbing and mechanical components.
9. Division 26 - Shop primed electrical components

1.2 REFERENCES

A. ACA American Coatings Association

1. ACA – Glossary of Terms

B. ASTM International:

1. ASTM D16 – Standard Terminology for Paint, Related Coatings, Materials and Applications.
2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. AWI Architectural Woodwork Institute

1. AWS – Architectural Woodwork Standards

D. CARB California Air Resources Board

1. CARB – Architectural Coatings - 2007 Suggested Control Measure.

E. EPA Environmental Protection Agency

1. EPA Test Method 24.

F. Green Seal:

1. GC-03 – Environmental Criteria for Anti Corrosive Paints.
2. GS-11 – Product Specific Environmental Requirements

G. Painting and Decorating Contractors of America

1. PDCA Standards.

H. South Coast Air Quality Management District:

1. SCAQMD Rule 1113 – Architectural Coatings

I. Society for Protective Coatings

1. SSPC – Steel Structures Painting Manual.

1.3 DEFINITIONS

A. Conform to ACA Glossary of Terms for interpretation of terms used in this section. Refer to ASTM D16 for terms not listed in ACA.

1.4 SUBMITTALS

A. Division 1 - Submittal Procedure: Submittal procedures.

B. Product Data: Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating specified requirements.

C. Samples: Furnish sufficient samples to establish full range of colors and textures for materials exposed in the finished Work. Label samples to indicate product and location in the Work. Samples will be reviewed for appearance only. Compliance with other requirements is the responsibility of the Contractor.

1. Opaque Colors and Finishes: Submit samples, on hardboard, using materials accepted for Project, of each color and paint finish selected with texture to simulate actual conditions. Prepare three samples, 8-1/2 inches by 11 inches, with required number of paint coats clearly visible.

D. Manufacturer's Installation Instructions: Submit special surface preparation procedures and substrate conditions requiring special attention.

E. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Air Quality Certificates: Certify volatile organic compound content for each interior sealant and related primer.

F. Provide product documentation that ensures paints/coatings meet LEED v4.1 VOC content and emissions requirements. See 01 81 13 Sustainable Design.

1.5 CLOSEOUT SUBMITTALS

A. Division 1 - Execution Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALITY ASSURANCE

A. Manufacturer and Applicator: Companies specializing in manufacturing and applying products specified in this section with minimum three years' experience.

B. Test galvanized surfaces for passivator removal prior to painting as specified in this Section, with project inspector or Architect present.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Product storage and handling requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

E. Store only acceptable Project materials on Project site.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 1 - Product Requirements.

B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

C. Do not apply exterior coatings during rain when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

1.9 SEQUENCING

A. Division 1 - Summary: Project phasing and work sequence.

B. Sequence application to the following:

1. Do not apply finish coats until paintable sealant is applied.
2. Back prime wood trim before installation of trim.

1.10 WARRANTY

A. Division 1 - Execution Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for paints and coatings.

C. Colors of all surfaces finished under this section shall, at the end of one year, have remained free from serious fading, and variations, if any, shall be uniform. All materials shall have their original adherence at the end of one year, and there shall be no evidence of blisters, running, peeling, scaling, chalking, streaks or stains at the end of this period. Washing with alkali-free soap and water shall remove surface dirt without producing any deteriorating effects.

1.11 EXTRA MATERIALS

A. Division 1 - Execution Requirements: Spare parts and maintenance products.

B. Supply 1 gallon of each color, type, and surface texture; store where directed.

C. Label each container with color, type, texture, and room locations in addition to manufacturer's label.

PART 2 – PRODUCTS

2.1 ACRYLIC PAINTS

A. Manufacturers: Furnish compliant products of one of the following or approved equal. Products used in combination shall be of a single manufacturer, and shall be compatible with each other. Acrylic Paint products of Kelly-Moore are listed below as the Basis of the Specification.

1. Benjamin Moore
2. Dunn Edwards
3. Frazee / Sherwin Williams
4. Kelly-Moore
5. PPG / Glidden Professional / Devoe

B. Interior Acrylic Primer: Vinyl acrylic resin.

1. VOC Limit Compliance: CARB and GS-11; 50 g/L maximum.
2. Basis of Specification: “971 AcryPlex Interior PVA Primer/Sealer”.

C. Interior/Exterior Acrylic Metal Primer: Direct-to-metal acrylic, rust-inhibitive/anti-corrosive.

1. VOC Limit Compliance: CARB and GC-03; 100 g/L maximum.
2. Basis of Specification: “5725 DTM Acrylic Primer / Finish”.

D. Exterior Acrylic Wood Primer: 100% acrylic resins, mildew-resistant. Formulated for cold-weather application.

1. VOC Limit Compliance: CARB; 100 g/L maximum.
2. Basis of Specification: “255 AcryShield 100% Exterior Wood Primer”.

E. Exterior Acrylic Masonry & Concrete Primer: 100% acrylic resins, akali-resistant. Formulated for cold-weather application.

1. VOC Limit Compliance: CARB; 100 g/L maximum.
2. Basis of Specification: “247 AcryShield 100% Exterior Masonry Primer”.

F. Interior Acrylic Finish: 100% acrylic resins, gloss level as specified and indicated on drawings.

1. VOC Limit Compliance: CARB and GS-11; 100 g/L maximum for non-flats, exclusive of colorants.
2. Solids Content by Volume: 40 percent minimum (+/- 2%) for “Eggshell” sheen (10-20 @ 60-degrees).
3. Basis of Specification: “1600-Series - AcryPlex 100% Acrylic Interior Enamel”.
4. Alternate at Overhead Structure: Contractor may substitute Acrylic Dryfall type flat finish on **exposed, overhead structure, ducts, pipes, conduit, et cetera. Color: As indicated on Drawings.**
    a. VOC Limit Compliance: CARB and GS-11; 50 g/L maximum.
    b. Solids Content by Volume: 29 percent minimum (+/- 2%).
    c. Basis of Specification: “Dry Fog II Flat Latex Maintenance Finish”.

G. Exterior Acrylic Finish: 100% acrylic resins, mildew resistant, gloss level as specified and indicated on drawings. Formulated for low temperature application.

1. VOC Limit Compliance: CARB; 100 g/L maximum for non-flats, exclusive of colorants.
2. Solids Content by Volume: 36 percent minimum (+/- 2%) for “Semi-Gloss” sheen (45-55 @ 60-degrees).
3. Basis of Specification: “1200-Series AcryShield 100% Acrylic Exterior Enamel”.

2.2 CLEAR COATINGS

A. Interior Clear Wood Finish: AWS Finishing System 12; water-based, non-yellowing polyurethane with satin sheen.

1. VOC Limit Compliance: CARB and SCAQMD; 275 g/L maximum.
2. Solids Content by Volume: 25 percent minimum.
3. Manufacturer and Product: Cabot's "Water-Borne Polyurethane No. 8082" or approved equal.

2.3 COMPONENTS

A. Paints and Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:

1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
2. For good flow and brushing properties.
3. Capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.

PART 3 – EXECUTION

3.1 GENERAL

A. Manufacturer's Instructions: Prepare substrates, apply primers and apply the work, including components and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions.

B. Prepare and finish surfaces as specified and as scheduled at end of the Section, and as shown. Unless otherwise shown or specified, all exposed paintable type surfaces - except where specified with factory finish in their respective sections - shall receive suitable paint finish, whether or not specifically scheduled.

1. Paintable surfaces include temporary barriers exposed to public, visitors and staff during construction.

C. Surfaces Not to be Painted:

1. Manufactured products with factory finish, fabric and glass components, as specified in various Sections.
2. Prefinished wall, ceiling, and floor coverings.
3. Painting specified elsewhere and included in respective Sections, including but not necessarily limited to, shop priming and high performance coatings.
4. Code-Required Labels: Keep equipment identification and fire rating labels free of paint.

5. Surfaces concealed in walls and above solid ceilings except as specifically indicated otherwise.

6. Ducts, piping, conduit, and equipment concealed in walls and ceilings, unless specifically indicated otherwise.

3.2 EXAMINATION

A. Division 1 – Administrative Requirements: Coordination and project conditions.

B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.

1. Verify smoothness of gypsum board finished surfaces for projection surface coating suitable for prime coat application.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Plaster and Gypsum Wallboard: 12 percent.

2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

3. Wood: 15 percent, measured in accordance with ASTM D4442.

3.3 PREPARATION

A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section. Remove or repair existing coatings exhibiting surface defects.

C. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium, tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

D. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

E. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

F. Copper Surfaces Scheduled for Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.

G. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces:

1. Clean and prepare with an etching metal prep and passivator remover.

2. To ensure removal of passivator coatings, test prepared area with two- to five-percent copper sulfate solution with project inspector or Architect present. If the galvanized surface blackens, the passivator has been removed and the surface is ready for coating system application.

3. If the copper sulfate solution has no effect on color of the galvanized surface, either re-treat with remover or lightly abrade it with a Scotch pad, using care not to remove layer of galvanization.

I. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

J. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

K. Uncoated Steel and Iron Surfaces: Refer also to Division 5. Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

L. Shop Primed Steel Surfaces: Refer also to Division 5. Sand and scrape to remove loose primer and rust. Remove any loose mill scale or mill scale flaking. Feather edges to make touch-up patches inconspicuous. Clean surfaces with a product compatible with the primer and the finish coating system. Re-prime shop primed items in accord with the specified coating system.

M. Interior Wood Items Scheduled to Receive Paint Finish: Refer also to Division 6. Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

N. Interior Wood Items Scheduled to Receive Transparent Finish: Refer also to Division 6. Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.

O. Exterior Wood Scheduled to Receive Paint Finish: Refer also to Division 6. Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail

holes with tinted exterior paintable caulking compound after prime coat has been applied.

P. Exterior Wood Scheduled to Receive Transparent Finish: Refer also to Division 6. Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.

Q. Metal Doors Scheduled for Paint Finish: Refer also to Division 8. Prime metal door top and bottom edge surfaces.

3.4 APPLICATION

A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.

C. Sand wood and metal surfaces lightly between coats to achieve required finish.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.

F. Finishing Mechanical and Electrical Equipment:

1. Refer to Divisions 21 through 26 for schedule of color coding and identification banding of equipment, duct work, piping, and conduit.

2. Paint shop primed equipment. Paint shop finished items occurring at interior areas.

3. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

4. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports except where items are shop finished.

5. Paint interior surfaces of air ducts visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

6. Paint exposed conduit and electrical equipment occurring in finished areas.

7. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

8. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated and matching existing. Color band and identify with flow arrows, names, and numbering.

9. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.5 FIELD QUALITY CONTROL

A. Division 1 - Execution Requirements: Testing, adjusting, and balancing.

3.6 CLEANING

A. Division 1 - Execution Requirements: Final cleaning.

B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.7 SCHEDULE - GENERAL REQUIREMENTS

A. General: Major material categories only are scheduled, but all miscellaneous items and areas within a room or space shall be treated with a suitable system, unless otherwise shown or specified. This specification shall serve as a guide and is meant to establish procedure, quality and minimum number of coats.

B. Coating Thickness: Acrylic primer and paint shall be applied to the manufacturer recommended dry film, per coat thickness and in no case less than 1.4 mils. Other products shall have a minimum dry mil thickness as recommended by manufacturer, unless mil thickness is specified. Mil thicknesses are minimums, not averages.

C. Number of Coats: Where number of coats is specified, it is only as a minimum requirement. Apply additional coats, at no additional cost to Owner, if necessary to completely hide base material, produce uniform color, and provide satisfactory finish result.

3.8 SCHEDULE - EXTERIOR SURFACES

A. Steel – Unprimed and Galvanized:

1. One coat of Interior/Exterior Acrylic Metal Primer.

2. Two coats Exterior Acrylic Finish, semi-gloss unless otherwise noted.

B. Steel - Primed:

1. Touch-up with Interior/Exterior Acrylic Metal Primer.

2. Two coats Exterior Acrylic Finish, semi-gloss unless otherwise noted.

C. Wood – Unprimed (Indicated on Drawings for Opaque Finish):

1. One coat Exterior Acrylic Wood Primer.

2. Two coats Exterior Acrylic Finish, semi-gloss unless otherwise noted.

D. Concrete and Masonry (Indicated on Drawings for Opaque Finish):

1. One coat Exterior Acrylic Masonry & Concrete Primer.
2. Two coats Exterior Acrylic Finish, semi-gloss unless otherwise noted.

3.11 SCHEDULE - INTERIOR SURFACES

A. Steel – Unprimed and Galvanized

1. One coat of Interior/Exterior Acrylic Metal Primer.
2. Two coats Interior Acrylic Finish, semi-gloss unless otherwise noted.

B. Steel - Primed:

1. Touch-up with Interior/Exterior Acrylic Metal Primer.
2. Two coats Interior Acrylic Finish, semi-gloss unless otherwise noted.

C. Gypsum Board:

1. One coat of Interior Acrylic Primer.
2. Two coats Interior Acrylic Finish, semi-gloss unless otherwise indicated.

D. Shop-Primed Hollow Metal Doors and Frames:

1. Sand smooth and fill dents with automotive type filler.
2. Two coats Interior Acrylic Finish, semi-gloss.

E. Wood – Opaque Finish:

1. One coat of Interior Acrylic Primer.
2. Two coats Interior Acrylic Finish, semi-gloss unless otherwise indicated.

F. Wood – Clear Finish

1. Two coats of Interior Clear Wood Finish.
2. Minimum dry film thickness: Not less than manufacturer’s recommended spreading rate.

3.12 SCHEDULE - COLORS

A. Architect reserves the right to select and vary colors on surfaces throughout the Work. Refer to requirements for samples and for mock-ups/field samples.

B. Colors: Refer to colors and locations on Drawings. Match the listed manufacturer’s standard colors:

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes high performance coatings and special preparation of surfaces, complete as shown and specified:

1. Steel handrails, stringers and metal pans at metal stairs.
2. Exposed HSS support steel and plates at roof screens
3. Corrugated panels at Roof Screen.
4. Aluminum door frames.
5. Interior Entrances and Storefronts mullions, frames and door stiles and rails. Two coat
6 .Exterior mechanical louvers.

B. Related Sections:

1. Section 01 81 13 – Sustainabile Design Requirements (CalGreen).
2. Section 05 50 00 – Metal Fabrications
3. Section 08 12 14 – Standard Steel Frames
4. Section 08 12 16 – Aluminum Door and Glazing Frames.
5. Section 08 13 14 – Standard Steel Doors.
6. Section 08 36 13 – Sectional Glass and Aluminum Overhead Doors
7. Section 08 41 13 – Interior Entrances and Storefronts
8. Section 08 44 13 – Glazed Aluminum Curtain Walls
9. Section 08 51 13 – Aluminum-Framed Storefronts and Entrances
10. Section 08 91 00 - Louvers
11. Section 09 90 00 - Painting and Coating.

1.2 REFERENCES

A. Green Seal:

1. GC-03 - Anti-Corrosive Paints.
2. GS-11 - Product Specific Environmental Requirements.

B. South Coast Air Quality Management District:

1. SCAQMD Rule 1113- Architectural Coatings.

C. SSPC: The Society for Protective Coatings:

1. SSPC SP 2 - Hand Tool Cleaning.
2. SSPC SP 3 - Power Tool Cleaning.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedure: Submittal procedures.

B. Product Data: Submit manufacturer’s literature and installation instructions for each material and accessory, clearly notating specified requirements.

C. Samples: Furnish sufficient samples to establish full range of colors and textures for materials exposed in the finished Work. Label samples to indicate product and location in the Work. Samples will be reviewed for appearance only. Compliance with other requirements is the responsibility of the Contractor.

1. Opaque Colors and Finishes: Submit samples, on hardboard, using materials accepted for Project, of each color and paint finish selected with texture to simulate actual conditions. Prepare three samples, 8-1/2 inches by 11 inches, with required number of paint coats clearly visible.

D. Manufacturer's Installation Instructions: Submit special surface preparation procedures and substrate conditions requiring special attention.

E. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Air Quality Certificates: Certify volatile organic compound content for each interior sealant and related primer.

1.4 CLOSEOUT SUBMITTALS

A. Division 1 - Execution Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit maintenance and cleaning requirements for coatings, repair and patching techniques.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years’ experience.

B. Applicator: Company specializing in performing work of this section with minimum three years’ experience and approved by manufacturer.

C. Test galvanized surfaces for passivator removal prior to painting as specified in this Section, with project inspector or Architect present.

1. On at least 100 square feet of surface as directed, provide full-coat finish samples until required sheen, color and texture are obtained.

1.6 DELIVERY, STORAGE AND HANDLING

A. Division 1 – Product Requirements: Product storage and handling requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Division 1- Product Requirements.

B. Do not install materials when ambient temperature is outside range required by coatings manufacturers, and in no case below 55 degrees F or above 90 degrees F.

C. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

D. Restrict traffic from area where coating is being applied or is curing.

1.8 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Warranty: Include installation coverage for bond to substrate, degradation of chemical resistance for a minimum of 5 years.

1.9 MAINTENANCE MATERIALS

A. Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Supply 1 gallon of each color of each type of coating specified, for Owner's maintenance use.

C. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

PART 2 – PRODUCTS

2.1 LEED REQUIREMENTS

A. For paints and coatings applied inside the weatherproofing line and applied on site, provide products with VOCs that comply with limits found in Section 018113 Sustainability Requirements.

2.2 MANUFACTURERS

A. High-Performance Fluoropolymer Coating at Exterior Steel Substrates:

1. Surface Preparation: SSPC-SP6/NACE3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

2. Shop Primer: Tnemec Series 90-97 Tneme-Zinc. Zinc-rich aromatic urethane. 2.5 to 3.5 mils DFT.

3. Field-Appled Finish Coat: Tnemec Series 1071V Fluoronar. Thermoset solution fluoropolymer. Semi-gloss finish. 2.0 to 3.0 mild DFT.

B. High-Performance Coatings at Interior Steel Substrates:

1. Shop Primer: Tnemec 27WB Typoxy. Apply at 3.0 to 5.0 mils DFT.

2. Touch all damaged or bare spots per SSPC-SP 15 (feather-in all edges) and spot prime with Tnemec 27WB at 3.0-4.0 mil DFT.

3. Field - Applied Finish Coat:

a. Semi-Gloss Sheen: Tnemec 750 UVX semi-gloss. Apply at 3.0 – 5.0 mils DFT.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces are ready to receive work as instructed by coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

3.2 PREPARATION

A. Clean surfaces of loose foreign matter.

B. Remove substances that would bleed through finished coatings. When removal is not possible, seal surface with shellac.

C. Remove finish hardware, fixture covers, and accessories and store.

D. Existing Painted and Sealed Surfaces:

1. Prepare per manufacturer’s recommendations.

2. Clean with mixture of trisodium phosphate and water to remove surface grease and foreign matter.

E. Galvanized Surfaces:

1. Clean and prepare with an etching metal prep and passivator remover.

2. To ensure removal of passivator coatings, test prepared area with two- to five-percent copper sulfate solution. If the galvanized surface blackens, the passivator has been removed and the surface is ready for coating system application.

3. If the copper sulfate solution has no effect on color of the galvanized surface, either re-treat with remover or lightly abrade it with a Scotch pad, using care not to remove layer of galvanization.

F. Ferrous Metal:

1. Solvent clean.

2. Remove loose rust, loose mill scale, and other foreign substances using hand tools according to SSPC-SP 2 or power tools according to SSPC-SP 3.

3. Protect adjacent surfaces and materials not receiving coating from overspray; mask when necessary to provide adequate protection. Repair damage.

3.3 INSTALLATION

A. Apply all components per manufacturer's recommendations and as specified.

B. Apply primer to previously uncoated surfaces, unless specifically not required by coating manufacturer.

C. Wood: Prior to priming patch with filler to produce smooth, even surface.

D. Concrete: Prior to priming, patch with masonry filler to produce smooth surface.

E. Apply coatings to thicknesses required.

F. 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.

3.4 CLEANING

A. Division 1 - Execution and Closeout Requirements: Final cleaning.

B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

C. Clean surfaces immediately of overspray, splatter, and excess material.

D. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of elastomeric coatings to exterior concrete masonry unit substrates.

B. Related Sections:

1. Section 01 81 13 – Sustainability Requirements.
2. Section 03 30 00 – Cast-in-Place Concrete.
3. Section 04 29 00 – Reinforced Unit Masonry.
4. Section 09 90 00 – Painting and Coating.
5. Section 09 96 00 – High-Performance Coatings.

1.2 REFERENCES

A. American society for Testing and Materials (ASTM):

1. ASTM D412 - Standard Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
2. ASTM D1653 - Standard Test Method for Water Vapor Transmission of Organic Coatings.
3. ASTM D2369 - Standard Test Method for Volatile Content of Coatings.
4. ASTM D6904 - Standard Practice for Resistance to Wind-Driven Rain for Exterior Coatings Applied on Masonry.

B. Sealant, Waterproofing, and Restoration Institute (SWRI):

1. SWRI Validation Program.

1.3 PERFORMANCE REQUIREMENTS

A. Resistance to Wind-Driven Rain: ASTM D6904; pass.

B. Moisture-Vapor Transmission: Minimum 12 perms, based on testing according to ASTM D1653.

C. Elongation: ASTM D412; 500 percent minimum.

D. Tensile Strength: ASTM D412; 250 psi minimum.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's literature and installation instructions for each material, including VOC content.

   1. Provide SWRI Validation Certificate for each coating specified to be validated by SWRI's Coating Validation Program.

B. Samples: Minimum 8-inches square, for each type of elastomeric coating indicated and in each selected color and gloss.

1.5 QUALITY ASSURANCE

A. Manufacturer and Applicator: Companies specializing in manufacturing and applying products specified in this section with minimum Five years' experience.

B. Material Compatibility:

   1. Materials for use within each paint system shall be 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, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Mockup: Apply mockups of each paint system indicated and each color and finish selected to demonstrate aesthetic effects and set quality standards for materials and execution.

   1. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.

   2. Final approval of color selections will be based on mockups. If preliminary color selections are not approved, apply one additional mockup of additional color selected by Architect at no added cost to Owner.

   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.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F

1.7 ENVIRONMENTAL CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 90 deg F unless otherwise permitted by manufacturer's written instructions.

B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

1.8 MAINTENANCE MATERIAL

A. 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.

B. Quantity: Furnish an additional 5 percent but not less than 1 gal. of each material, color, and texture applied.

1.9 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace elastomeric coatings that fail within ten (10) years from date of Substantial Completion. Failures include water penetration through the coating and deterioration of coating beyond normal weathering.

PART 2 – PRODUCTS

2.1 ELASTOMERIC COATINGS

A. Manufacturers: Furnish compliant products of one of the following or approved equal:

1. Dow Chemical Company.

2. Mapei.

3. Sherwin Williams.

B. Product Description: SWRI certified, single-component, fluid applied, water-based, pigmented silicone elastomer. Basis of Specification: Dow Chemical Company’s “DOWSIL AllGuard”.

1. Color: As selected by Architect from manufacturer’s full, standard range.

2. Surface Profile: Smooth.

3. Volatile Organic Compound (VOC) Content: Less than 50 g/L.

2.2 ACCESSORY MATERIALS

A. General: Furnish the following when recommended by manufacturer for specific project conditions.

B. Crack Fillers: Elastomeric coating manufacturer's recommended, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated.

C. Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated.

D. Concrete Unit Masonry Block Filler: Elastomeric coating manufacturer's recommended, factory-formulated, high-performance latex block filler compatible with substrate and other materials indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for maximum moisture content, alkalinity, and other conditions affecting performance of work.

B. Begin coating only when moisture content of substrate is 12 percent or less when measured with an electronic moisture meter.

C. Begin coating no sooner than 28 days after substrate is constructed and is visually dry on both sides.

D. Preinstallation Testing: Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

1. Conduct field tests for adhesion, alkalinity and moisture level as required for manufacturer’s warranty.

E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.

B. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.

2. Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.

C Fill cracks according to manufacturer's written instructions before coating surfaces.

3.3 APPLICATION

A. Apply elastomeric coatings according to manufacturer's written instructions.

1. Unless otherwise noted, use equipment and techniques best suited for substrate and type of material being applied.

2. Coat surfaces behind movable items the same as similar exposed surfaces.

3. Apply each coat separately according to manufacturer's written instructions.

B. Primers: Apply at a rate to ensure complete coverage.

C. Block Fillers: Apply at a rate to ensure complete coverage with pores filled.

D. Elastomeric Finish Coats: Minimum two coats with a total dry film thickness in accordance with manufacturer’s recommended total dry film thickness, and not less than 16 to 18 mils.

E. Tint each undercoat a lighter shade of selected finish color to facilitate identification of each coat. Tint undercoats similar to color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

F. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform finish, color, and appearance.

G. Apply coatings 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.

H. Apply coatings to prepared surfaces as soon as practicable after preparation and before subsequent surface soiling or deterioration.

I. Spray Application: Use spray equipment for application only when permitted by authorities having jurisdiction. Wherever spray application is used, do not double back with spray equipment to build up film thickness of two coats in one pass.

3.4 CLEANING AND PROTECTION

A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Work includes interior concrete floor dust sealer and hardener at rooms with exposed concrete floors.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 03 30 00 – Cast In Place Concrete.

1.2 REFERENCES

A. American Concrete Institute (ACI).

1. ACI 302 - Guide for Concrete Floor and Slab Construction.

B. South Coast Air Quality Management District

1. SCAQMD Rule 1113 - Architectural Coatings.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer’s literature and installation instructions.

1.4 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Products delivered to the job site shall be in the original unopened containers or wrappings.

B. Store materials in a clean, dry area in accordance with manufacturer's instructions. Keep products from freezing.

C. Avoid direct contact with this product as it may cause mild to moderate irritation of the eyes and/or skin.

D. Protect materials during handling and application to prevent damage or contamination.

1.5 QUALITY ASSURANCE

A. Indoor Environmental Quality Characteristics

1. Coatings: Comply with SCAQMD Rule 1113 VOC limits.

B. Concrete Floor Classifications

1. Recommended for ACI 302, Class 1 through 4 concrete floors.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not proceed with application of materials when concrete temperature is less than 40°F or above 135°F.

B. Do not apply materials unless surface to receive coating is clean and dry.

C. Do not use on highly dense or non-porous surfaces.

PART 2 – PRODUCTS

2.1 CONCRETE HARDENER AND DENSIFIER (DUST SEALER)

A. Manufacturers: Provide one of the following or approved equal.

1. Laticrete International, Incorporated “Seal Hard”.
2. Sonneborn / BASF “Lapidolith”.
3. SpecChem, LLC. “SpecHard”.
4. W.R. Meadows Incorporated “Liqui-Hard”.

B. Product Description: Waterbased, colorless, ready to use liquid concrete densifier and chemical hardener formulated with chemically reactive raw materials to harden and dustproof concrete.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive dust sealer and hardener. Notify architect if surfaces are not acceptable. Do not begin application until unacceptable conditions have been corrected.

B. Ensure material can penetrate the concrete surface.

3.2 SURFACE PREPARATION

A. Protect adjacent surfaces not designated to receive treatment.

B. Clean and prepare surfaces to receive treatment in accordance with manufacturer's instructions, ensuring that all stains, oil, grease, form release agents, dust, and dirt are removed prior to application.

3.3 APPLICATION

A. Apply two coats of concrete dust sealer and hardener in accordance with manufacturer's instructions.

B. Do not dilute concrete sealer.

C. Saturate the surface with undiluted concrete dust sealer and hardener by sprayer, squeegee or broom.

D. Keep the surface wet with concrete dust sealer and hardener for a minimum of 30 minutes. (A range of 30-60 minutes may be required depending on temperature and conditions.)

E. Ensure areas are kept wet at all times with concrete dust sealer and hardener.

F. Once the surface begins to gel and become slippery, immediately spray the surface with a light water mist.

G. Scrub the surface with a broom or mechanical scrubber to increase the penetration of the concrete densifier and chemical hardener.

H. Continue to work the concrete dust sealer and hardener into the surface for another 5-10 minutes or until it becomes gelled and slippery for a second time.

I. Thoroughly flush the surface with water and agitate the surface with a broom to aid in removal of the excess concrete dust sealer and hardener.

J. Remove all excess material with mop or squeegee. Thoroughly squeegee the surface dry.

K. Repeat for second application.

3.4 CLEANING

A. Remove debris resulting from completion of coating operation from the project site.

3.5 PROTECTION

A. Keep surface dry for a minimum of 48 hours after application.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes field-applied dry erase wall coverings.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.
2. Section 09 21 16 – Gypsum Board Assemblies.
3. Section 10 11 00 – Visual Display Units for surface-mount marker trays installed over dry erase wall coverings.

1.2 REFERENCES

A. ASTM International:

1. ASTM D523 – Standard Test Method for Specular Gloss.
2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
3. ASTM F793 - Standard Classification of Wall Covering by Use Characteristics.

B. Green Seal:

1. GS-11 - Green Seal Standard for Paints, Coatings, Stains, and Sealers.

C. South Coast Air Quality Management District:

1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 SUBMITTALS

A. Division 1- Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Manufacturer information regarding covering and adhesive indicating products meet or exceed specified requirements.
2. Manufacturer’s detailed instructions on installation requirements, with special procedures and perimeter conditions requiring special attention.

C. Samples: Submit two 12-inch x 12-inch samples of each covering specified, illustrating color, texture and finish.

D. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Indoor Environmental Quality Certificates: Certify volatile organic compound content for each wall covering and adhesive.

1.4 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Submit information regarding cleaning, touchup, and repair of covered surfaces. Provide precautions against cleaning materials and methods that may be detrimental to finish and performance.

1.5 QUALITY ASSURANCE

A. Surface Burning Characteristics: ASTM E84, Class A, maximum 25/450 flame spread/smoke developed index.

B. Indoor Environmental Quality Characteristics:

1. Adhesives: Maximum VOC content according to SCAQMD Rule 1168.

2. Flat and Non-Flat Paints & Primers: Maximum VOC content according to GS-11.

C. Manufacturer and Installer: Companies specializing in manufacturing and installing Products specified in this section with minimum three years' experience.

1.6 MOCKUPS

A. Division 1 - Quality Requirements: Requirements for mockup.

B. Size: Construct mockup, size as indicated by Architect, illustrating installed covering and joint seaming technique.

C. Locate mockup where directed by Architect. Approved mockup may be incorporated as part of Work.

D. Maintain mockups to serve as the standard of quality for this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in manufacturer's original packaging. Inspect for damage.

C. Protect materials from moisture and dust by storing in clean, dry location according to manufacturer's instructions. Do not store roll goods on end.

D. Protect packaged adhesive from temperature cycling.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 1 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install wall coverings until space has been enclosed and is watertight, wet work is complete and dry and adjacent and related work is completed.

C. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by adhesive manufacturer or by vinyl covering product manufacturer.

D. Subsequent Conditions: Maintain recommended conditions 24 hours before, during, and after installation of adhesive and covering.

1.9 EXTRA MATERIALS

A. Division 1 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Furnish 25 linear feet of each specified version of covering. Package and label each roll by manufacturer, color, and pattern.

C. Store extra materials where directed by Owner.

1.10 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Requirements for warranties.

B. Material: Warrant coverings to remain free of defects for a period of ten (10) years from date of substantial completion.

PART 2 – PRODUCTS

2.1 DRY ERASE WALL COVERINGS

A. Manufacturers: Furnish compliant products of the following or approved equal:

1. IdeaPaint

B. Product Description: Paper-backed, polymeric-coated film of polyethylene terephthalate, for a low-sheen wall-covering suitable for dry erasability and projection, meeting ASTM E84, Class A criteria.

1. Roll Width: 48 inches minimum.
2. Gloss Level: As established in conformance with ASTM D523:
   a. 20-Degrees: >38 GU
   b. 60-Degrees: >43 GU
   c. 85-Degrees: >48 GU
3. Color: White.

2.2 ACCESSORIES

A. Stainblocking Primer: Manufacturer's GS-11 compliant, standard primer formulated for use with wall covering, or recommended wallpaper primer.

B. Adhesive: SCAQMD Rule 1168-compliant, as recommended by covering manufacturer to suit application to substrate.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that substrate surfaces are ready to receive Work of this Section, and that they comply with requirements of covering manufacturer.

C. Wall surfaces shall be dry and free of dirt, grease, loose paint and scale.

D. Verify that flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet, or vary at rate greater than 1/16 inch per foot.

3.2 PREPARATION

A. Division 1 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Fill cracks in substrate, smooth irregularities with filler, and sand smooth.

C. Sand and wash impervious surfaces, rinse and neutralize, and then wipe dry.

D. Correct defects and clean surfaces that affect Work of this Section. Remove existing coatings that exhibit loose surface defects. Surface shall be brought to a minimum Level 4 finish before the application of wallcovering.

E. Treat surface with stainblocking primer as directed by manufacturer's instructions.

F. Apply primer sealer to substrate surfaces as directed by manufacturer instructions.

G. Plan wallcovering installation so as to limit number of seams and orient symmetrically. Horizontal seams are not acceptable.

3.3 INSTALLATION

A. Apply adhesive to wall or covering surface as directed by manufacturer, immediately prior to application of covering. Do not overapply adhesive.

B. Install covering in pattern sequence in accordance with manufacturer's recommendations and to meet layout established during Preparation.

C. Razor-trim edges according to manufacturer's instructions.

D. Apply covering smooth, and without wrinkles, gaps, or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

E. Remove excess adhesive while wet from seam before proceeding to next covering sheet. Wipe clean with dry cloth.

F. Wait 24 hours before using.

3.4 CLEANING AND PROTECTION

A. Division 1 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean coverings of excess adhesive, dust, dirt, and other contaminants.

C. Protect installed product and finished surfaces from damage during construction.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes markerboard ("whiteboard") units or walls, tackboard ("bulletin board"), factory and/or field assembled to sizes indicated on Drawings; and, loose marker trays for installation over dry erase wallcoverings.

B. Related Sections:

1. Section 09 21 16 – Gypsum Board Assemblies.
2. Section 09 97 37 – Dry Erase Wall Coverings
3. Division 26 – Electrical: Coordination with lighting control devices, wall outlet locations.
4. Division 27 – Communications: Coordination with device locations.

1.2 REFERENCES

A. ASTM International:

1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
4. ASTM F2034 - Standard Specification for Linoleum Sheet Floor Covering.

B. Porcelain Enamel Institute:

1. PEI S-104 Performance Specification for Porcelain Enamel Markerboards and Chalkboards.

C. South Coast Air Quality Management District:

1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on white boards, trim and accessories. Include certification of VOC-compliant adhesives and core material urea-formaldehyde content.

1.4 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit Operation and Maintenance Data.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years' experience.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.7 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for visual display boards.

C. Warranty: Include coverage of markerboard surface from discoloration due to cleaning, crazing or cracking, staining.

PART 2 – PRODUCTS

2.1 VISUAL DISPLAY BOARDS

A. Manufacturers: Furnish compliant products of one or more of the following or approved equal. Furnish single manufacturer per classification of visual display board.

1. Claridge Products and Equipment, Incorporated.
2. Marsh Industries, Incorporated.
3. Platinum Visual Systems
4. PolyVision Americas.
5. Steelcase.

B. Marker Board Type "WB1" - Porcelain enameled steel face, narrow profile trim (where provided) with continuous solid pen tray with smoothly curved and polished ends. Provide smooth butt-joints at face, concealed fasteners and hanger devices. Basis of Specification: Platinum Visual Systems' "Narrow Hanger Trim System (NTS)". Size: 48 inches high, length as indicated on Drawings.

2.2 COMPONENTS

A. Outer Steel Face Sheet: PEI S-104; porcelain enamel finished steel, 28 gauge minimum.

1. Maximum Size Available: 4 foot by 16 foot length minimum when required.

B. Markerboard Core: ASTM E84; Class A medium density fiberboard or mineral fiberboard, nominal 1/2 inch thick minimum, with no added urea-formaldehyde resins.

C. Markerboard Backing Surface: ASTM B209; aluminum sheet, 0.005 inch thick minimum. Foil backing not acceptable.

D. Markerboard Splice Joint: Concealed spline of sheet steel where required.

E. Tackboard Face: ASTM E84, Class B; 1/4 inch thick homogenous linoleum surface calendared on manufacturer's standard backing.

F. Aluminum Frame: ASTM B221, 6063 alloy, T5 temper. 3/4 inch maximum profile; concealed fasteners, and integrated hanger to coordinate with concealed hanger bars. Pen tray where Specified. No map rail.

2.3 ACCESSORIES

A. Adhesives: Manufacturer's recommended with maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

B. Hanger Bars: Manufacturer's standard for concealed mounting of frame to wall.

C. Marker Tray: Standard continuous solid aluminum chalktray with ribbed section and smoothly curved and polished ends aluminum with smoothly curved, polished ends; clear anodized. Platinum Visual Systems' CR315, or approved equal.

D. Screw-On Marker Tray Trim For Installation @ DEW Walls: Platinum Visual Systems' CR310, or Claridge Products and Equipment, Inc. "Chalk/Maker Tray Model No. 264", or equal. Provide size, in single units, and configuration shown on Drawings.

1. Mounting: Exposed fasteners for surface-mount over specified dry-erase wall covering (DEWP/DEW) per Section 09 97 37 Dry Erase Wall Coverings

2. Aluminum Finish: Clear anodic finish.

E. Adhesive-Backed Marker Tray For Installation @ DEW Walls: Claridge Products and Equipment, Inc. "Adhesive-Backed Tray Model No. GM-Tray 1", or equal. Provide 12"-long, in single units, and configuration shown on Drawings.

1. Mounting: Manufacturer's standard double-sided tape for surface-mount over specified dry-erase wall covering (DEW) per Section 09 97 37 Dry Erase Wall Coverings.

2. Aluminum Finish: Satin anodized finish.

F. Temporary Protective Cover: Adhered polyethylene or other sheet, manufacturer's standard.

2.4 FACTORY FINISHING

A. Porcelain Enamel: Glass fibered enamel, baked to vitreous surfaces; standard white color, high gloss.

B. Aluminum Frame and Accessories: Anodized to clear satin finish.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Coordination and project conditions.

B. Verify internal wall blocking is ready to receive Work and positioning dimensions are as indicated on drawings.

3.2 INSTALLATION

A. Secure units level and plumb.

B. Butt multiple adjacent panels tight with concealed spline to hairline joint.

C. Carefully cut holes in markerboards for wall switches and other devices so that cover plates will conceal holes. Do not locate devices within markerboard field unless position is specifically dimensioned on drawings. Otherwise, review with Architect prior to locating.

D. Furnish one magnetic marker tray for each face sheet panel.

3.3 CLEANING

A. Division 1 - Execution and Closeout Requirements: Final cleaning.

B. Cover chalkboard surfaces with protective cover, taped to frame.

C. Remove temporary protective cover at date of Substantial Completion.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Non-internally illuminated panel signs.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings

1. Include plans, elevations of all faces with message/icons, sections, details, and mounting/ footing attachments to other existing surfaces.

2. Provide message list, typestyles, graphic symbols, and layout for each sign at least half size and full-size details of graphic layouts.

3. Include full-size templates for cutout characters and graphic symbols.

C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:

1. Acrylic Sheet

D. Samples for Verification: For each of the following products and for full range of color and sign material indicated, of sizes indicated:

1. Acrylic Sheet: 8 x 8 inches for each color / finish required.

2. Full size representative samples of specified typestyles of tactile and surface printed characters and graphic symbols.

3. Hardware: Actual sample of each type.

1.3 QUALITY ASSURANCE

A. Installer Qualifications TBD.

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.

C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.

D. Regulatory Requirements: Comply with applicable provisions in the California Building Code and ADA-ABA Accessibility Guidelines and ICC A117.1.

E. Pre-fabrication Samples: Construct samples to verify selections made under sample submittals, demonstrate aesthetic effects, and set quality standards for materials and execution. Comply with the following requirements, using materials indicated for the completed Work:

1. Prepare one representative sample for each Sign Type specified in paragraph 2.2.

2. Sign Subcontractor to provide samples in on- or off-site location and of size indicted, or if not indicated, as directed by the Project Representative.

3. Employ workers that will be employed during the project fabrication, and supervisory personnel who will oversee the sample fabrication.

4. Demonstrate the proposed range of aesthetic effects and workmanship.

5. Sign Subcontractor to provide notice to Project Representative 14 days in advance of dates & times when samples will be available for review.

6. Sign Subcontractor required to receive Project Representative's approval of samples prior to fabrication of Work in this section. Allow 21 days for initial review and each re-review of each sample.

7. Sign Subcontractor to provide resubmit samples as required to obtain Project Representative's approval.

8. Sign Subcontractor to retain samples during construction in an undisturbed condition as a standard for judging the completed work.

9. Sign Subcontractor to remove samples when directed. When permitted by the Project Representative, approved samples may become part of the completed Work.

F. Pre-installation Conference: Conduct conference at Project site:

1. Sign Subcontractor to provide review of and finalize construction schedule and verify availability of materials, Sign Subcontractor's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Sign Subcontractor to provide review temporary protection requirements for signage during and after installation.

G. "Related Sections" heading in the technical specifications is included only to help guide Contractor to other Sections related to Work of that Section. Completeness is not guaranteed nor should it be interpreted as in anyway controlling Contractor's right to distribute Work.

1.4 PROJECT CONDITIONS

A. Weather Limitations: Sign Subcontractor to proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Sign Subcontractor to provide verification of sign locations by field measurements before fabrication and indicate measurements on Shop Drawings.

C. Sign Subcontractor to provide final attachment method information in Shop Drawings.

1.5 COORDINATION

A. Coordinate installation of anchorages for signage requiring hardware mounting. Furnish setting drawings, templates, and directions for installing anchorages and other items that are to be embedded in surfaces.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of pylon signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following

a. Deterioration of sign materials beyond normal weathering.

b. Deterioration of tactile graphics and graphic image colors.

2. Warranty Period: Sign Subcontractor to provide information determined from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 SUMMARY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Thomas Swan Sign Company

2. Martinelli Environmental Graphics

3. Creo Industrial Arts

4. Priority Signs

5. Arrow Signs

B. Changeable Message Inserts: Fixed non-glare, clear acrylic “window” to receive paper name insert.

1. Furnish insert material and template for creating text and symbols for [PC-Windows] [Macintosh] computers for owner production of paper inserts.

C. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with California Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by California Grade 2 Braille. Produce precisely formed

letters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

1. Panel material: 3/16” thick acrylic or aluminum (exterior).
2. Raised copy Thickness: 1/32 inch minimum.

D. Sign Schedule.

1. Exterior Panel Signs
   a. Sign Size: See Design Intent Drawings.
   b. Panel Material: 3/16” thick aluminum.
   c. Finish / Color: See Design Intent Drawings.
   d. Mounting: Fix sign panel with 316 stainless steel studs, 1/16” thick VHB double-faced foam tape and clear silicone adhesive.
2. Interior Panel Signs
   a. Sign Size: See Design Intent Drawings.
   b. Panel Material: 3/16” thick acrylic.
   c. Finish / Color: See Design Intent Drawings.
   d. Mounting: Fix sign panel with 1/16” thick VHB double-faced foam tape and clear silicone adhesive.
3. Other Sign Types TBD

PART 3 – EXECUTION (TBD)

END OF SECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Solid Color Reinforced Composite (SCRC) Substrate, Toilet Partitions.

1.2 RELATED SECTIONS

A. Section 05 50 00 - Metal Fabrications.

B. Section 06 10 00 - Rough Carpentry.

C. Section 10 28 13 - Toilet Accessories.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

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. USA Certificate of Origin: Manufacturer shall supply with first submittal, an example of their Certificate of Origin declaring toilet compartments are wholly manufactured and assembled specifically in the United States, including city and state locations. A notarized Certificate of Origin shall be provided with closeout documents.

D. Shop Drawings: Submit manufacturer's shop drawings for each product specified, including the following:
   1. Plans, elevations, details of construction and attachment to adjacent construction.
   2. Show anchorage locations and accessory items.
   3. Verify dimensions with field measurements prior to final production of toilet compartments.

E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 10 year experience manufacturing similar products.

B. Installer Qualifications: Minimum 2 year experience installing similar products.

C. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.

D. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirements as applicable.

1.5 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

B. Handling: Handle materials to avoid damage.

1.7 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 recommended limits.

1.8 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. Manufacturer's standard 1 year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Products: Based on the quality and performance requirements of the project, specifications are based on the products of Bobrick Washroom Equipment, 3092G.67P Sierra Series SCRC solid phenolic toilet partitions in custom heights.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 SOLID COLOR REINFORCED COMPOSITE (SCRC) SUBSTRATE

A. Solid Color Reinforced Composite (SCRC) Toilet Partitions: Bobrick Sierra Series.
   1. Design Type:
      a. Maximum Height:
         1) Door/Panel Overall Component Height: 90”.
         2) Doors to run up to headrail, see elevations.
         3) Floor Clearance standard stalls: 3/4” AFF.
         4) Floor Clearance ADA stalls: 3/4” AFF.
         5) Door clearance: ¾” AFF.
   2. Privacy Style Partitions: No sightlines with gap-free interlocking doors and stiles routed 0.300 inches (7.6 mm) from the edge to allow for 0.175 inch (4.4

mm) overlap to prevent line-of-sight into the toilet compartment. Privacy strips fastened or adhered onto the partition material are not acceptable.

3. Mounting Configuration:
   a. Floor-mounted, overhead-braced with satin finish, extruded anodized aluminum headrails, 0.065 inch (1.65 mm) thick with anti-grip profile.
      1) Stile Maximum Height: 90 inches (211 cm).

B. Materials: Solid color reinforced composite (SCRC) material for stiles, panels, doors, and screens with Bobrick GraffitiOff coating, thermoset and integrally fused into homogenous piece; high density polyethylene (HDPE), high density polypropylene not acceptable.
   1. Composition: Dyes, organic fibrous material, and polycarbonate/phenolic resins.
   2. Surface Treatment: Non-ghosting, graffiti resistant surface integrally bonded to core through a manufacturing steps requiring thermal and mechanical pressure.
   3. Edges: Same color as the surface.

C. Color:
   1. As indicated on Drawings.

D. Fire Resistance:
   1. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class B / Uniform Building Code: Class II.
      a. Flame Spread Index (ASTM E 84): 75 or less.
      b. Smoke Developed Index (ASTM E 84): 450 or less.

E. Finished Thickness:
   1. Stiles and Doors: 3/4 inch (19 mm).
   2. Panels and Screens: 1/2 inch (13 mm).

F. Stiles: Floor-anchored stiles furnished with expansion shields and threaded rods.
   1. Leveling Devices: 7 gauge, 3/16 inches (5 mm) thick, corrosion-resistant, chromate-treated, double zinc-plated steel angle leveling bar bolted to stile; furnished with 3/8 inch (10 mm) diameter threaded rods, hex nuts, lock washers, flat washers, spacer sleeves, expansion anchors, and shoe retainers.
   2. Stile Shoes: One-piece, 22 gauge (0.8 mm), 18-8, Type 304 stainless steel, 4 inch (102 mm) height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch (19 mm) or 1 inch (25 mm) stile thickness and capable of being fastened (by clip) to stiles starting at wall line.

G. Anchors: Expansion shields and threaded rods at floor connections as applicable. Threaded rods secured to supports above ceiling as applicable. Supports above ceiling furnished and installed as Work of Section 05 50 00 - Metal Fabrications.

H. Hardware: All hardware to be concealed inside toilet compartments by factory installed threaded brass inserts at all fastening points, tested up to 1,500 ponds of pull force per insert. Exposed hardware unacceptable. Exception: Outswing doors.
   1. Compliance: Operating force of less than 5 lb (2.25 kg).

2. Emergency Access: Hinges, latch allow door to be lifted over keeper from outside compartment on inswing doors.
3. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish.
4. Fastening: Hardware is secured to door and stile with pin-in-head Torx stainless steel machine screws. Hinges, latch and optional door stops secured to door with pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners for hinges, latch and optional door stops secured directly into core not acceptable.
   a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lb (680 kg) per insert.
5. Clothes Hooks: Projecting no more than 1-1/8 inch (29 mm) from face of door.
6. Door Occupancy Indicator Latch: Manufactured from stainless steel, allows patrons to quickly identify what stalls are occupied/unoccupied (Red/Green).
7. Locking: Door locked from inside by sliding door latch into keeper.
8. Hinge Type:
   a. Standard.
      1) Balanced, with field-adjustable cam to permit door to be fully closed or partially open when compartment is unoccupied.
9. Mounting Brackets:
   a. Full-Height.
      1) Mounting Brackets: 18 gauge (1.2 mm) stainless steel and extend full height of panel.
      2) U-Channels: Secure panels to stiles.
      3) Angle Brackets: Secure stiles-to-walls and panels to walls.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare substrates including but not limited to blocking and supports in walls and ceilings at points of attachment using methods recommended by the manufacturer for achieving the best result for the substrates under the project conditions.
   1. Inspect areas scheduled to receive compartments for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.
   2. Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.

B. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

C. Do not proceed with installation until substrates have been properly prepared with blocking and supports in walls and ceilings at points of attachment and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

3.2 INSTALLATION

A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:

1. Verify blocking and supports in walls and ceilings has been installed properly at points of attachment.
2. Verify location does not interfere with door swings or use of fixtures.
3. Use fasteners and anchors suitable for substrate and project conditions
4. Install units rigid, straight, plumb, and level.
5. Conceal evidence of drilling, cutting, and fitting to room finish.
6. Test for proper operation.

3.3 ADJUSTING, CLEANING AND PROTECTION

A. Adjust hardware for proper operation after installation. Set hinge cam on in-swinging doors to hold doors open when unlatched. Set hinge cam on out-swinging doors to hold unlatched doors in closed position.

B. Touch-up, repair or replace damaged products.

C. Clean exposed surfaces of compartments, hardware, and fittings.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes folding panel acoustic partitions; ceiling track and operating hardware.

B. Related Sections:

1. Section 05 50 00 – Metal Fabrications: Components for overhead support.
2. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking and track support shimming.
3. Section 08 71 00 – Door Hardware: Lock cylinders for hardware.
4. Section 09 21 16 – Gypsum Board Assemblies: Coordination with wall and ceiling assemblies, including overhead acoustical barrier.
5. Division 9: Coordination with floor finishes.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
4. ASTM E413 - Classification for Rating Sound Insulation.
5. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions.

B. South Coast Air Quality Management District:

1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 PERFORMANCE REQUIREMENTS

A. Sound Transmission Classification (STC): As specified, calculated in accordance with ASTM E413, based on tests performed in accordance with ASTM E90, on partition size of 100 sq ft.

1.4 SUBMITTALS

A. Division 1 - Submittal Procedures: Submittal procedures.

B. 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, and stacking sizes.

C. Product Data: Submit data on partition operation, hardware and accessories, track switching components, colors and finishes available.

D. Samples for Review: Submit samples of surface finish, 12 x 12 inches size, illustrating quality, colors selected and texture.

E. Manufacturer's Instructions: Submit special procedures, perimeter conditions requiring special attention and installation sequence.

F. Certificates:

1. Certify partition system meets or exceeds specified acoustic requirements.

2. Certify installer’s qualifications.

1.5 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to fabric surfaces and hardware finish.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years’ experience.

B. Installer: Company specializing in performing work of this section and approved by manufacturer.

1.7 COORDINATION

A. Division 1 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with other sections providing panel finish materials to this section.

PART 2 – PRODUCTS

2.1 OPERABLE PANEL PARTITIONS

A. Manufacturers:

1. Nanawall

a. Product Description: NanaWall HSW60 is Basis of the Specification. Manual operation, Standard top-hung, single-track, interlocking aluminum-framed

sliding glass storefront system panel. Manufacturer's standard frame and panel profiles, with head track, stacking bays, side jambs, sliding panels with dimensions as shown on Drawings. Sound Transmission Class: STC 39 for entire assembly.

2.2 COMPONENTS

A. Panels:

1. Size: 10'-0" high. Widths as shown on drawings.

2. Provide clear anodized aluminum head track with aluminum covers on both sides that match aluminum profile finish.

3. Head rail: 4-5/16 x 2-5/16 inch.

4. Jamb rail: 5-1/4 x 2-5/16 inch.

5. Bottom rail width:
   a. 2-3/8 inch
   b. Manufacturer's standard kickplate 6" high.

6. Aluminum Extrusion:
   a. Thickness: 0.078 inch

7. Finish:
   a. Powder coat: From manufacturer's full RAL selection. High gloss. Color: to match ~~Kawneer 789G048 Permadize "Light Sequin"~~ **PPG Industries' Duranar XL #3ZMA3190 – "Ultra-Cool Champagne"** to match glazed aluminum curtain wall.

B. Glass and Glazing:

1. Safety Glazing: In compliance with ANSI Z97.1 and CPSC 16CFR 1201.
   a. Glass Acoustical Performance: STC 41, 1 inch, double IGU, air filled, double-laminated clear glass.

2. Manufacturer's tempered and laminated glass lites, dry glazed with grey seals and glass stops on the inside.
   a. Glass lite / Insulated Glass Unit (IGU)
      1) Double IGU: 15/16 inch thick. Air filled.
   b. Glass Spacers: Manufacturer's standard grey.

C. Locking Hardware and Handles:

1. Main Entry Panel(s) for Models WITH Swing Panel(s): Provide manufacturer's standard lever handles on the inside and outside, and a standard lockset with a lockable latch and multi-point locking with a dead bolt and rods at the top and bottom.
   a. Rods to be concealed and not edge mounted.
   b. After turn of key or thumbturn, depression of handles withdraws latch.

c. Lifting of handles engages rods and turn of key or thumb turn engages deadbolt and operates lock.
d. Lever Handles - Finish: Brushed satin stainless steel.

2. Secondary Panels: Provide manufacturer's standard flat handles, brushed satin stainless steel finish. Handles and concealed one or two point locking hardware operated by 180º turn of handle. Face applied flush bolt locking not acceptable.

3. Handle Height: 41-3/8 inch centered from bottom of panel or as otherwise indicated.

4. Aluminum locking rods with standard fiberglass reinforced polyamide end caps at the bottom (and top on certain panels). Rods to have a stroke of 15/16 inch (24 mm).

5. Additional profile cylinders to be keyed alike.

6. Incorporated Swing Panel: Provide crank handle stored in flap on panel stile to convert sliding panel to a swing panel and vice versa.
   a. Conversion Box located on upper arm of top rail to be polyamide in silver gray finish.

NOTE: If swing door to frame fixing hardware for operation of the incorporated door is above 7'-0" (2.13 m), provide with an integrated pole for single person operation.

Operation above 7'-0" (2.13 m) should be easy to complete and not require additional mean to reach the fixing/locking mechanism other than the provided pole.

7. Swing Door Attachment: Geared positive attachment only to affix swing door to the frame for incorporated swing doors for ease of operation and rigid security.

8. Pinch Resistance: Provide rounded extrusions on pivot side of incorporated swing panels.

D. Standard Flush Sill:

1. Finish: Aluminum with a clear anodized finish.

E. Fasteners: Stainless steel machine screws for connecting frame components.

2.3 FABRICATION

A. Extruded aluminum frame and panel profiles, corner connectors and hinges, sliding hardware, locking hardware and handles, glass and glazing components to construct sliding glass wall with stacking bays.

1. Each unit factory pre-assembled and shipped with all components and installation instructions.

2. Exposed work to be carefully matched to produce continuity of line and design with all joints.

3. No raw edges visible at joints.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examination and Acceptance of Conditions per Section 01 70 00 and as follows:

1. Carefully examine rough openings with Installer present, for compliance with requirements affecting Work performance.
   a. Verify that field measurements, substrates, tolerances, levelness, plumbness, cleanliness and other conditions are as required by the manufacturer, and ready to receive Work.
   b. Verify the structural integrity of the header for deflection with live and dead loads limited to the lesser of L/720 of the span or 1/4 inch (6 mm). Provide structural support for lateral loads, and both wind load and eccentric load when the panels are stacked open.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install Sliding Glass Storefront system in accordance with the Drawings, approved submittals, manufacturers' recommendations and installation instructions, and as follows:

1. Properly flash, waterproof and seal around opening perimeter.

2. Securely attach anchorage devices to rigidly fit frame in place, level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work

3. When lower track is designed to drain, provide connections to allow for drainage.

4. Install panels, handles, lock set, and other accessories in accordance with manufacturer’s recommendations and instructions.

3.3 FIELD QUALITY CONTROL

A. Field Tests and Inspections per Section 01 40 00 of the following:

1. Verify the Sliding Glass Storefront system operates and functions properly. Adjust hardware for proper operation.

B. Non-Conforming Work: Repair or replace non-conforming work as directed by the Architect; see General and Supplementary Conditions, and Division 01, General Requirements.

3.4 CLEANING AND PROTECTION

A. Keep units closed and protect Sliding Glass Storefront installation against damage from construction activities.

B. Remove protective coatings and use manufacturer recommended methods to clean exposed surfaces.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Work includes provision of protective wall coverings, wall corner guards, and related accessories.

B. Work Specified Elsewhere:

1. Section 09 21 10 – Gypsum Board Assemblies.

1.2 References:

A. American Society for Testing and Materials International (ASTM):

1. ASTM E84: Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. No Product Data submittals required unless products and systems used deviate from those listed in Part 2 of this Section.

B. Product Data: Submit manufacturer's literature and installation instructions for each material and accessory, clearly notating specified requirements.

C. Samples: Minimum 6-inch square of each specified sheet product finish and 6 inch length of each corner guard product finish.

D. Maintenance Manual: Three printed copies of manufacturer's recommendation of care, cleaning, and maintenance.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and store packaged materials in original containers with seals unbroken and labels intact until time of use.

1.5 ENVIRONMENTAL CONDITIONS

A. Temperature: Maintain areas to receive protective wall covering at reasonably constant temperature of not less than 50 degrees F for at least three days before and during application period.

PART 2 – PRODUCTS

2.1 PROTECTIVE WALL COVERING:

A. Manufacturers: Provide compliant products of one of the following or approved equal:

1. Construction Specialties, Incorporated.

2. InPro Corporation.

B. Product Description: ASTM E84 Class A, PVC-free, impact, chemical and stain resistant rigid polyethylene terephthalate glycol (PETG) sheet with butt vertical seams. Basis of Specification: Construction Specialties' "Acrovyn 4000 Wall Covering".

1. Thickness: 0.060 inch.
2. Texture: "Suede".
3. Color: No. 858 "Pumice".
4. Adhesive: Manufacturer's standard water-based, 50 g/L VOC maximum.

2.2 CORNER GUARDS:

A. Manufacturers: Provide compliant products of one of the following or approved equal:

1. Construction Specialties, Incorporated.
2. InPro Corporation.

B. Product Description: Basis of Specification: Construction Specialties' "CO-8".

1. Size: 2 inch x 2 inch. 16 ga.
2. 304 Stainless Steel with #4 satin finish.
3. Adhesive applied.

PART 3 – EXECUTION

3.1 GENERAL:

A. Manufacturer's Instructions: Prepare substrates and install the work, including components and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions.

B. General: Set work accurately in location, alignment, and elevation; plumb, level, true, and free of rattle or vibration except where expansion-contraction tolerances are required; measured from established lines and levels.

3.2 PREPARATION:

A. Remove hardware, accessories, plates, and similar items prior to installing wall covering. Upon completion of each space, replace removed items.

3.3 INSTALLATION:

A. Install items in accordance with manufacturer's printed instructions. Install protective wall covering and corner guards without horizontal seams.

B. Remove access adhesive immediately from wall surface as each joint or seam is made, and before proceeding to next joint or seam.

C. Assure installation is secure, smooth, clean, without gaps and edges not adhered to backing surface.

3.4 CLEANING:

A. Thoroughly clean items after installation in accordance with manufacturer's printed instructions.

3.5 PROTECTION:

A. Protect work from damage to surface and remove protective covering prior to final acceptance.

B. Replace damaged items.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes toilet**,** ~~and~~ janitor's closet accessories**, and waste receptacles**.

B. Related Requirements:

1. Section 09 21 16 – Gypsum Board Assemblies: Backing for mounting of accessories
2. Section 10 21 13 - Toilet Compartments.
3. Division 26 – Electrical: Provision of power to electrical accessories.

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A123 - Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A153 - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
3. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
4. ASTM A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
5. ASTM A666 - Standard Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
6. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
7. ASTM C1036 - Standard Specification for Flat Glass.

1.3 PERFORMANCE REQUIREMENTS

A. Installation of grab bars and attachments shall be adequate to resist minimum 250 lb. concentrated load applied at any point in any direction.

1.4 COORDINATION

A. Division 1 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with placement of internal wall reinforcement and where required reinforcement of toilet partitions to receive anchor attachments.

1.5 SUBMITTALS

A. Division 1 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on accessories, describing size, finish, details of function, and attachment methods.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

1.7 WARRANTY

A. Division 1 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish five-year manufacturer's warranty for electric hand dryers.

C. Furnish fifteen-year manufacturer's warranty for mirror glass and stainless steel mirror frames.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer List: Except where equal products are identified as acceptable below, provide without substitution the products listed below.

2.2 MATERIALS

A. Accessories: 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 weld joints smooth.

2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Furnish two keys for each keyed accessory to Owner; master key accessories to Owner's system].

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269, Type 304 stainless steel.

E. Mirror Glass: ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality Q1 mirror select; type with copper and silver coating, and organic overcoating.

F. Fasteners, Screws, and Bolts: Manufacturer’s standard stainless steel or ASTM A153 hot-dip galvanized, tamper-proof.

G. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 TOILET ROOM ACCESSORIES

A. Grab Bars 'GB' : Surface-mounted, stainless steel satin finish. 1-1/2 inches outside diameter, minimum 18 gauge wall thickness, concealed flange mounting with snap flange cover. 1-1/2 inches exact clearance between wall finish and inside of mounted grab bar. Furnish manufacturer's standard through-mounting kit where mounting required at toilet compartment panel. Bobrick Washroom Accessories' "B-6806".

1. Lengths: Minimum 42-inch (GB42) at rear of water closet, minimum 48-inch (GB48) at side of water closet, and as indicated on Drawings. (OFCI)

B. Paper Towel Dispenser 'PTD': Kimberley Clark Hands Free, Sanitouch #09990 (Black) (OFCI)

C. Soap Dispenser 'SD': GoJo/FMX/Gray #5250-09 (No substitution) 2000ml . (OFCI)

D. Mirrors 'M1': Surface-mounted, satin stainless steel framed, 1/4 inch thick float glass mirror. Mitered, welded, ground and polished frame corners. Full-mirror, minimum 0.03 inch galvanized steel sheet backing and non-absorptive filler material. Bobrick Washroom Equipment Incorporated's "B-165 1836" or equal. (CFCI)

E. Recessed Seat-Cover Dispenser, Sanitary Napkin Disposal and Toilet Tissue Dispenser 'SCD'/'SND'/'TPD': Bobrick ClassicSeries® Stainless steel "B-3574" (CFCI)

F. Coat Hook 'CH': Surface-mounted, stainless steel. Bobrick Washroom Equipment Incorporated's "B-76727" or equal. (OFCI)

G. Baby Changing Station 'BCS': Koala Kare Model "KB110 -SSRE" (OFCI)

H. Waste Receptacle 'WR': Recessed waste receptacle, Type-304 stainless steel. Bobrick "B-35643" (OFCI)

I. Sanitary Napkin Vendor 'SNV': Sanitary Napkin / Kotex Vendor Bobrick "B-47069"

J. Hand Dryer 'HD': Dyson Airblade V

2.4 JANITOR'S CLOSET ACCESSORIES

A. Mop and Broom Holder: Surface-mounted, stainless steel. Bobrick Washroom Equipment Incorporated's "B-223 x 24".

B. Utility Shelf with Mop / Broom Holders Bobrick "B-239"

2.5 WASTE RECEPTACLES

A. General: Furnish receptacles of type and quantity as indicated below. Rubbermaid Commercial models are listed as the Basis of the Specification.

1. Trash: One receptacle in each classroom, office, and cubicle.

2. Recycle:

a. Small: One receptacle in each office and cubicle.
b. Medium: One receptacle in each classroom.

B. Receptacles:

1. Trash Receptacle (Medium): 7 gallon (28 quart) capacity. Color: Black. Nominally 14.5”x10.5”x15.0” (LxWxH). Model No. FG295600BLA.

2. Recycle Receptacle (Small): 3.25 gallon (13 quart) capacity. Color: Blue. Nominally 11.38”x8.25”x12.13” (LxWxH). Model No. FG295573BLUE.

3. Recycle Receptacle (Medium): 7 gallon (28 quart) capacity. Color: Blue. Nominally 14.5”x10.5”x15.0” (LxWxH). Model No. FG295600BLUE.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Requirements for installation examination.

B. Verify exact location of accessories for installation.

C. Verify field measurements and rough-in dimensions for recessed accessories are as indicated on product data.

D. Comply with Manufacturer’s installation instructions, Drawings and Section 09 21 16 for installation of anchorage backing in walls.

3.2 PREPARATION

A. Division 1 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Deliver inserts and rough-in frames to Site for timely installation.

C. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Do not install accessories until after completion of all finishes to adjacent wall and ceiling surfaces.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Turn over to Owner all keys and special tools required for lockable or secured accessories.

D. Mounting Heights and Locations: As indicated on Drawings.

E. Furnish one Mop and Broom Holder at each Janitor’s closet

3.4 REPAIR

A. Clean and repair existing toilet accessories that remain or are to be reinstalled.

3.5 CLEANING

A. Division 1 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean mirrors and exposed surfaces using procedures as recommended by accessory manufacturer.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Work includes fire extinguishers and fire extinguisher cabinets.

B. Related Sections:

1. Section 06 10 53 – Miscellaneous Rough Carpentry: Wood blocking and shims.

2. Section 09 21 16 – Gypsum Board Assemblies.

1.2 REFERENCES

A. California Code of Regulations - Title 24, Part 9.

1. CFC – California Fire Code (Current).

B. National Fire Protection Association (NFPA).

1. NFPA 10 – Standard for Portable Fire Extinguishers.

C. Underwriters Laboratories Inc. (UL).

1. UL – Fire Protection Equipment Directory.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10 and California Fire Code.

B. Provide fire extinguishers classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.

C. Provide fire-rated versions of specified fire extinguisher cabinets when installed into fire-rated walls and partition assemblies. Cabinets shall be classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated, with rating equal or greater to that of the wall or partition assembly.

D. Projection of semi-recessed fire extinguisher cabinet handles shall not exceed 4 inches from face of adjacent wall surface.

1.4 SUBMITTALS

A. Product Data: Submit extinguisher operational features, fire-resistive rating where applicable, color and finish, anchorage details.

1. Manufacturer’s Installation Instructions: Submit special criteria and wall opening coordination requirements.

1.5 QUALITY ASSURANCE

A. Coordination:

1. Wall Depths: Verify wall and partition assemblies will suit sizes and locations of fire extinguisher cabinets.

2. Fire Extinguisher Type and Capacity: Coordinate fire extinguisher cabinets to ensure proper fit.

1.6 PROJECT CONDITIONS

A. Do not deliver or install extinguishers until just before Substantial Completion.

B. Do not use permanent fire extinguishers for construction period fire protection.

PART 2 – PRODUCTS

2.1 FIRE EXTINGUISHER CABINETS

A. Manufacturers: Furnish compliant products of one of the following or approved equal:

1. Activar Inc. / J.L. Industries.

2. Larsen's Manufacturing Company.

3. Nystrom Building Products

B. General: Steel cabinet box, rated or non-rated, powdercoat or baked enamel finish.

1. Inside dimensions: Coordinate size with specified fire extinguisher.

2. Door and Frame: Aluminum, clear satin anodized.

3. Door Style: Full panel clear acrylic glazing.

4. Basis of Specification: Larsen's "Occult Series". Model O-2409. Stainless steel door and frame. Vertical duo door with Larsen-Loc and clear tempered glazing in door. Black vertical diecut lettering.

C. Cabinet Type "FEC-1" - Fully-Recessed, "FEC-2" – Fully-Recessed, Fire Rated cabinet

2.2 FIRE EXTINGUISHERS

A. Manufacturers:

1. Activar Inc. / J.L. Industries.

2. Kidde Fire Extinguishers.

3. Larsen's Manufacturing Company.

4. Nystrom Building Products.

5. Potter Roemer.

B. Fire Extinguishers: Multi-purpose 5 lb. capacity extinguishers for Class ABC fires with minimum UL 2A-10B:C rating. Furnish one extinguisher for each cabinet or bracket-type mounting location. Furnish manufacturer's compatible standard mounting bracket with each extinguisher. Basis of Specification: Larsen's "Model MP5".

PART 3 – EXECUTION

3.1 GENERAL

A. Manufacturer's Instructions: Prepare substrates and install the work, including components and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions. Provide wall backing for anchorage whether shown or not. Coordinate cutouts in architectural finishes and wall paneling where cabinets and boxes are installed through them.

3.2 INSTALLATION

A. Perform installation in accordance with the manufacturer's instructions except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

B. Install cabinets at locations and at heights indicated, square and plumb and aligned with any cut-outs in architectural wall finishes. Where back of cabinet door will project more than one-half inch beyond face of any architectural finish panel, furnish Semi-Recessed option with return trim to suit. Install extinguishers inside fire extinguisher cabinets.

C. Substantial Completion: Determine date of Substantial Completion of Work. Inspect, charge, and tag fire extinguishers within 10 days before Substantial Completion date.

D. Install extinguishers in cabinets.

3.3 ADJUSTING AND CLEANING

A. General: Adjust fire extinguisher cabinets to operate without binding. Verify hardware is working properly.

B. Clean surfaces as recommended by the manufacturer.

C. Touch-Up: Use materials recommended by manufacturer. If cabinet cannot be restored to factory-finished appearance, replace cabinet.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Solid plastic lockers.

1.2 RELATED SECTIONS

A. Division 06 Section 06 10 53 Miscellaneous Rough Carpentry for locker anchorage.

1.3 REFERENCES

A. ASTM International (ASTM):

1. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
2. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. US Federal Government:

1. U.S. Architectural & Transportation Barriers Compliance Board. Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).

C. GREENGUARD Environmental Institute (GREENGUARD):

1. GREENGUARD certified low emitting products.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets for each type of product indicated include fabrication details, description of materials and finishes.

1. Product Test Reports: When requested by Architect, provide documentation indicating compliance of products with requirements, from a qualified independent testing agency.

B. Shop Drawings: Include overall locker dimensions, floor plan, elevations, sections, details, and attachments to other work. Include choice of options with details.

C. Samples for Selection: Furnish samples of manufacturer's full range of colors for initial selection.

D. Samples for Approval: Furnish a physical sample of the material in the selected color.

1. Size: 6 by 6 inch (102 by 102 mm) in type of finish specified.

E. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include breakout costs for each product with recycled content.

1.5 INFORMATIONAL SUBMITTALS

A. Installation instructions.

B. Warranty: Sample of special warranty.

1.6 MAINTENANCE SUBMITTALS

A. Operation and Maintenance Data.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Approved manufacturer listed in this section, with minimum **[**5**]** years experience in the manufacture of plastic lockers. Manufacturers seeking approval must submit the following in accordance with Instructions to Bidders and Division 01 requirements:

1. Product data, including test data from qualified independent testing agency indicating compliance with requirements.
2. Samples of each component of product specified.
3. List of successful installations of similar products available for evaluation by Architect.
4. Submit substitution request not less than 15 days prior to bid date.

B. Installers Qualifications: An experienced Installer regularly engaged in the installation of lockers for a minimum of 3 years.

C. Source Limitations: Obtain plastic lockers and trim accessories from single manufacturer.

D. Accessibility Requirements: Comply with requirements of ADA/ABA and with requirements of authorities having jurisdiction.

E. 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: 100 or less.

2. Smoke-Developed Index: 450 or less.

PART 2 - PRODUCTS

2.1 PLASTIC LOCKERS

A. Manufacturer: Furnish compliant products of one of the following or approved equal:

1. Bradley Corporation.

2. Hadrian.

3. Republic.

B. MATERIALS

1. High Density Polyethylene (HDPE): 30 percent pre-consumer recycled content polyethylene thermoplastic formed under high pressure into solid plastic components.
2. Stainless-Steel Sheet: ASTM A 666, Type 304.
3. Fasteners: Tamper-Resistant Fasteners: Stainless steel torx-head screws.

   a. Locker Connectors: No. 10-24 sex bolts.
   b. Anchors: Type and size required for secure anchorage.
   c. Drilled-in-place Masonry Anchors: Minimum 1/4 by 1-3/4 inch (6 by 44 mm) screws.

2.2 STANDARD PLASTIC LOCKERS

A. Basis-of-Design Product: Bradley Corporation's "LENOXLOCKER".

B. Locker Configuration: Refer to Drawings.

C. Locker Dimensions

1. Height, Nominal 72 inch
2. Width: 12 inch and 15 inch
3. Depth: 15 inch

D. Material: HDPE plastic, 30 percent recycled material.

E. Sides, Tops, Bottoms, Dividers, and Shelves: 3/8 inch (10 mm) thick HDPE plastic with smooth finish.

F. Locker Shelves: 3/8 inch (10 mm) HDPE plastic, mortised into sides and back.

G. Locker Tops: Slope top.

H. Doors: Fabricate from a single piece 1/2 inch (13 mm) HDPE plastic.

1. Doors and Frame: 1/2 inch (13 mm) thick HDPE plastic with matte texture finish.

2. Handle: ADA/ABA Compliant handle fabricated from injection molded plastic.Locks: Built-in combination lock.Hinges: Continuous piano hinges, .05 inch/18 gauge (1.27 mm) thick type 304 stainless steel fabricated to wrap around edges of door and frame and attached with stainless steel tamper-resistant screws.

   a. Finish: Powder coated to match color of locker.

3. Latch Bar: Full-height latch bar constructed of 1/2 inch (13 mm) HDPE plastic secured to locker with stainless steel tamper-resistant screws.

I. Color: Basis of Design Manufacturer's "Canyon Granite M244", or as selected from other manufacturer's standard.

J. Accessories:
1. End Panels: **[**3/8 inch (10 mm)**]** **[**1/2 inch (13mm)**]** thick, with color and finish matching locker body.
2. Filler Panels: 1/2 inch (13 mm) HDPE filler panel, with color and finish matching locker body, attached with 3/8 inch (10 mm) thick HDPE solid plastic angle bracket.
3. Wall Hooks: Black powder coated, cast zinc hook one per locker.
4. Number Plate: White acrylic with black film coating, laser etched with number specified. Provide one per locker.
5. Locker Base: 1 inch (26 mm) solid HDPE plastic, with black or finish matching locker body, 4 inch (101 mm) high.
6. Lock: Locker manufacturer's digital combination lock.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers in climate controlled environment, shielded from direct sunlight.

B. General: Install on floor or other firm support. Install level, plumb, and true.

1. Position locker base per approved shop drawing. Using fasteners provided by manufacturer, anchor base sections to the floor.
2. Attach filler pieces to lockers with male-female sex bolts.
3. Position first locker according to submittal layout. Square and plumb the locker using concealed shims. Secure the locker to the wall at the top and bottom of the locker. Position second locker next to first, square and plumb to align the tops and bottoms; and temporarily clamp lockers together. Drill four holes through the sides of the lockers and connect lockers using sex bolts provided by manufacturer.

C. Accessories: Fit exposed connections of trim, fillers, and closures together to form tight, hairline joints, with concealed fasteners and splice plates furnished by locker manufacturer. Install as indicated on approved shop drawings.

1. Identification Plates: Identify plastic lockers with approved identification numbers. Attach plates to each locker door.
2. Filler Panels: Attach with concealed fasteners.
3. Sloping Tops: Attach sloping-tops to plastic lockers, with closures at exposed ends.
4. Finished End Panels: Attach at ends indicated.

3.2 FINAL CLEANING

A. Clean locker interior and exterior surfaces.

B. Remove packaging and construction debris and legally dispose of off-site.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pre-fabricated metal storage and metal shelving.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal storage shelving.

B. LEED Submittals:
1. For Credit MR 4, submit manufacturer's product data that delineates % of recycled content by weight. Provide material costs for post-consumer and pre-consumer recycled content. Only include materials permanently installed on the project site.
2. For Credit MR 5, submit a list of products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site. Include the cost and percentage of each material, by weight. Provide documentation from manufacturer that confirms the address of the place of manufacture and verifies the method of transit. If a product has multiple points of assembly, provide detailed data on location and assembly.
3. For Credit IEQ 4.1, submit product data for adhesives and sealants used inside the weatherproofing line, indicating VOCs comply with limits found in Section 01 81 13 "LEED Requirements."
4. For Credit IEQ 4.2, submit product for paints and coatings used inside the weatherproofing line, indicating VOCs comply with limits found in Section 01 81 13 "LEED Requirements."

C. Shop Drawings: For customized metal storage shelving. Include plans, elevations, sections, details, and attachments to other work. Include installation details of connectors, lateral bracing, and special bracing.

D. Samples: For units with factory-applied color finishes. Include similar Samples of accessories involving color selection.

E. Product Schedule: For metal storage shelving.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of metal storage shelving from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal storage shelving to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project. Installer shall have not less than 5 years of experience installation of metal storage shelving similar to that required for this project.

B. Source Limitations: Obtain metal storage shelving from single source from single manufacturer.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, 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.

1.8 COORDINATION

A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.

B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

PART 2 - PRODUCTS

2.1 LEED REQUIREMENTS

A. MR 4: Provide products that contain recycled content.

B. MR 5: Provide products that are extracted, harvested, recovered, or manufactured within 500 miles of the project site, depending on its method of transportation to the project site.

C. IEQ 4.1: For adhesives and sealants used inside the weatherproofing line and applied on site, provide products with VOCs that comply with limits found in Section 018113 “LEED Requirements.”

D. IEQ 4.2: For paints and coatings applied inside the weatherproofing line and applied on site, provide products with VOCs that comply with limits found in Section 018113 “LEED Requirements.”

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Attachment of double-faced shelving to the supporting floor structure, and of single-faced shelving to wall construction shall be designed in accordance with structural criteria requirements of CBC Table 1607A and ASCE Table 13.5-1.

C. Regulations: Provide shelving systems, including all related components and anchorages, capable of withstanding seismic forces in compliance with applicable requirements of CBC Chapter 16A. Details of construction and installation shall be approved by the Division of the State Architect (DSA).
   1. Comply with CFC Section 2703.8.7 for hazardous materials and CRC 3403.2 for flammable/combustible materials.

2.3 MATERIALS

A. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

C. Steel Tubing: ASTM A 513, Type 2.

D. Steel Wire: ASTM A 899.

E. Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde.

F. Composite Wood 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."

G. Floor Anchors: Galvanized-steel, post-installed expansion anchors, power-actuated fasteners or threaded concrete screws. Simpson Strong-Tie Titen HD 5/8" x 4" Hex Washer Head Screw Anchor with Anchor Plate for Wide span storage Rack H-1523ANCHOR. Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.

H. Wall Anchors: Manufacturer's standard, galvanized-steel anchors designed to secure metal storage shelving to adjacent wall. Hillman Hangman Furniture Ant-Tip Kit. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

2.4 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Uline, Pleasant Prairie, WI
   2. Global Industrial, Port Washington, NY

B. Like materials shall be the products of one manufacturer and shall be either the ones upon which the design is based or equal products of other manufacturers accepted in advance in accordance with Section 01 33 00.

2.5 CASE-TYPE METAL STORAGE SHELVING

A. General: Factory-formed, field-assembled, freestanding, case-type metal storage shelving system, designed for shelves to span between and be supported by sheet metal end panels (without posts), with shelves adjustable over the height of shelving unit. Fabricate shelf units with end panel at each end so each unit is independent. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

B. Types: Janitor/Storage shelving, to be braced Bulk Storage Racks, manufactured by ULine, or equal.
   1. Type S-1: Fixed 3-Shelf Bulk Storage Rack with 5/8" particle board shelves, 48 in. long by 12 in. deep by 72 in. high; Model #: H-2498
      a. Add one (1) additional shelf, Model #: H-2496-ADD, each unit.

   2. Type S-2: Fixed 3-Shelf Bulk Storage Rack with 5/8" particle board shelves, 36 in. long by 12 in. deep by 72 in. high; Model #: H-2497.
      a. Add one (1) additional shelf, Model #: H-2495-ADD, each unit.

   3. Type S-3: Fixed 3-Shelf Bulk Storage Rack with 5/8" particle board shelves, 48 in. long by 18 in. deep by 72 in. high; Model #: H-1523.
      a. Add one (1) additional shelf, Model #: H-2190-ADD, each unit.

   4. Type S-4: Fixed 3-Shelf Bulk Storage Rack with 5/8" particle board shelves, 36 in. long by 18 in. deep by 72 in. high; Model #: H-2206
      a. Add one (1) additional shelf, Model #: H-2188 ADD, each unit.

5. Type S-5: Fixed 3-Shelf Bulk Storage Rack with 5/8" particle board shelves, 36 in. long by 24 in. deep by 72 in. high; Model #: H-1888
    a. Add one (1) additional shelf, Model #: H-2189 ADD, each unit.

6. Type S-6: Fixed 3-Shelf Bulk Storage Rack with 5/8" particle board shelves, 48 in. long by 24 in. deep by 72 in. high; Model #: H-1524
    a. Add one (1) additional shelf, Model #: H-2191 ADD, each unit.

7. Type S-7: Fixed 3-Shelf Bulk Storage Rack with 5/8" particle board shelves, 60 in. long by 18 in. deep by 72 in. high; Model #: H-1525
    a. Add one (1) additional shelf, Model #: H-2194 ADD, each unit.

8. Type S-8: Fixed 3-Shelf Bulk Storage Rack with 5/8" particle board shelves, 72 in. long by 24 in. deep by 72 in. high; Model #: H-1528
    a. Add one (1) additional shelf, Model #: H-2199 ADD, each unit.

9. Type S-9: Fixed 3-Shelf Bulk Storage Rack with 5/8" particle board shelves, 60 in. long by 24 in. deep by 72 in. high; Model #: H-1526
    a. Add one (1) additional shelf, Model #: H-2195 ADD, each unit.

C. Types: Wall Mounted shelving, secured to in wall backing with surface mounted heavy duty single slot wall standards with 1" slots on 2" centers, satin zinc, two per each section of shelving. Provide two shelf brackets per shelf.

1. Type WS-1: Adjustable 4-shelf wall-mount solid ½" thick melamine shelving, 48 in. long by 18 in. deep by 48" high. By Global Industrial.

2. Type WS-2: Adjustable 4-shelf wall-mount solid ½" thick melamine shelving, 36 in. long by 18 in. deep by 48" high. By Global Industrial.

3. Type WS-3: Adjustable 4-shelf wall-mount solid ½" thick melamine shelving, 36 in. long by 12 in. deep by 48" high. By Global Industrial.

4. Type WS-4: Adjustable 4-shelf wall-mount solid ½" thick melamine shelving, 36 in. long by 24 in. deep by 48" high. By Global Industrial.

5. Type WS-5: Adjustable 4-shelf wall-mount solid ½" thick melamine shelving, 72 in. long by 12 in. deep by 48" high. By Global Industrial

6. Type WS-6: Adjustable 4-shelf wall-mount solid ½" thick melamine shelving, 24 in. long by 18 in. deep by 48" high. By Global Industrial

7. Type WS-7: Adjustable 4-shelf wall-mount solid ½" thick melamine shelving, 48 in. long by 12 in. deep by 48" high. By Global Industrial

8. Type WS-8: Adjustable 4-shelf wall-mount solid ½" thick melamine shelving, 28 in. long by 12 in. deep by 48" high. By Global Industrial

9. Type WS-9: Single wire shelf, wall mounted, 48” long by 18” deep x 14” high by U-Line. Model H-4796

D. Storage Cabinets, to be braced, manufactured by Line or equal.

1. Type C-1 Welded Storage Cabinets, 14 gauge powdercoat finish, 36 long by 24” deep by 74” high. Model #H-4459, each unit by ULine.

2. Type C-2 Welded Storage Cabinets, 14 gauge powdercoat finish, 48” long by 24” deep by 74” high. Model #H-44, each unit by ULine.

3. Type C-3 Welded Storage Cabinets, 14 gauge powdercoat finish, 48” long by 18” deep by 74” high. Model #H-44, each unit by ULine.

2.6 FABRICATION

A. Shop Fabrication: Prefabricate shelving components in shop to greatest extent possible to minimize field fabrication; temporarily preassemble shelving components where necessary to ensure that field-assembled components fit together properly. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Fabricate metal storage shelving square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.

1. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
2. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
3. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
4. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.

C. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

D. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch. Shear and punch metals cleanly and accurately. Remove burrs.

E. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components

to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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.

2.8 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling."

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where metal storage shelving will be installed.

C. Examine substrates to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Vacuum finished floor over which metal storage shelving is to be installed.

3.3 INSTALLATION

A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.

1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
3. Adjust post-base bolt leveler to achieve level and plumb installation.
4. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
5. Install seismic restraints.
6. Connect shelving units together.
7. Install shelves in each shelving unit at spacing indicated on Drawings or, if not indicated, at equal spacing.

    a. Case-Type Metal Storage Shelving: Install adjustable shelf clips at front and back of each shelf.

3.4 ERECTION TOLERANCES

A. Erect case-type metal storage shelving to a maximum tolerance from vertical of 1/2 inch in up to 10 feet of height, not exceeding 1 inch for heights taller than 10 feet.

3.5 ADJUSTING

A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.

B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.

C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

D. Replace metal storage shelving that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes stand-alone roof equipment screens, supporting steel framework and accessories.

B. Related Sections:

1. Section 05 12 00 – Structural Steel: Metal framing.

2. Section 05 31 00 – Steel Decking.

3. Section 05 50 00 - Metal Fabrications: Frames and supports.

4. Section 07 54 23 – Thermoplastic Polyolefin Roofing: Flashing of roofing at base of steel frames.

5. Division 23 - Roof Top HVAC Equipment.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA):

1. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

B. American Society of Civil Engineers (ASCE):

1. ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures.

C. American Society for Testing and Materials International (ASTM):

1. ASTM A792 - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

D. American Welding Society (AWS):

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

2. AWS D1.1 – Structural Welding Code – Steel.

3. AWS D1.6 - Structural Welding Code – Stainless Steel.

1.3 PERFORMANCE REQUIREMENTS

A. Provide metal wall panels designed to resist the following, in accordance with ASCE/SEI 7:

1. Wind Loads: Determine loads based on uniform pressure as identified on Drawings.

2. Deflection Limits: Metal wall panel assemblies shall withstand horizontal deflections no greater than L/240 of the span.

B. Installed panels shall accommodate expansion and contraction under normal conditions without causing detrimental effect to system components and anchorage.

1.4 SUBMITTALS

A. Submit in accordance with Division 1 – Submittals.

B. Product Data: Manufacturer's data sheets on each product to be used, including installation methods.

C. Shop Drawings: Layout and erection drawings showing typical cross sections and dimensioned locations of all frames and base supports. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

D. Samples: Minimum 12" x 12" sample of each grille or screen panel specified, showing profile, pattern and finish of each.

E. Welders Certificates: Certify products meet or exceed specified requirements.

F. Warranties.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Panel manufacturer with a minimum five years documented experience in producing screens.

B. All welds to be performed by an AWS certified welder. Valid certification to be provided.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the project site clearly marked for proper identification.

B. Receive, handle and store materials in conformance with the manufacturers printed instructions.

C. Store products under cover, in manufacturer's unopened packaging until ready for installation. Protect materials from exposure to moisture.

1.7 PROJECT CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Field Measurements: Verify roof screen dimensions and conditions of the installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

A. Panel Finish: Provide written material warranty stating that the paint finish applied on all equipment enclosure panels will be warranted against chipping, peeling, cracking, fading, or blistering for the coverage period of twenty (20) years.

B. Panel Installation: Provide written installation warranty stating that for a period of five (5) years the assembled panel screens will be free of rattles, vibration harmonics, damage caused by thermal movement, or loosening of attachments.

PART 2 – PRODUCTS

2.1 EXTERIOR GRILLES AND SCREENS

A. Manufacturer: Furnish compliant products of one of the following or approved equal. Kingspan/Morin's Model BR7-35 is the Basis of the Specification.

1. AEP Span.

2. Kingspan Group / Morin.

3. Nucor / Centria.

B. Product Description: ASTM A792, engineered for exposed fastening, 1-1/2" deep profile perforated with 1/8-inch holes at 3/8-inch spacing, formed of minimum 24 gauge galvalume and as require to meet performance requirements based upon designed support spacing under horizontal application.

1. Panel Trim: Same material and finish as panel, 24 gauge minimum. Configuration as shown in Drawings.

2. Panel Fasteners: No. 14 self-tapping sheet metal screws with neoprene washers, with color-coated heads to match panel finish.

3. Furnish sheet steel framing components, fasteners and other components as required for complete installation of grilles and screens.

2.2 ACCESSORIES

A. Steel support frames shall be galvanized and furnished as indicated on Drawings in accordance with Division 5.

B. Metal Framing: Galvanized steel sheet as specified in Section 05 50 00.

1. Hat-Shaped, Rigid Furring Channels: 16 gauge, 1-inch depth.

2. Cold-Rolled Furring Channels: 16 gauge, depth as indicated on Drawings.

C. Bolts, Nuts and Washers: Stainless steel, as specified in Section 05 50 00.

D. Self-Drilling Screws: Carbon steel with factory applied protective coating conforming to ASTM B 117 salt spray testing.

E. Welding Materials: AWS D1.1; type required for materials being welded.

2.3 FABRICATION

A. Form metal wall panels to lap with edges of adjacent panels which are then mechanically attached through panel to supports using color-coated fasteners with a neoprene washer.

B. Panels shall be factory formed. Field formed panels are not acceptable.

C. Curved wall panels: Panels shall be factory curved as approved by manufacturer.

D. Mitered Corners: Structurally bonded horizontal outside or inside trimless corners matching metal wall panel material, profile and factory applied finish shall be fabricated by metal wall panel manufacturer.

1. Welded, riveted or field fabricated corners are not acceptable.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Fabricate system components so that portions of screen can be dismantled for repairs to equipment being screened and for future roof replacement.

2.4 SCREEN FINISHES

A. Superior-Performance Organic Finish – Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Apply finish to both sides of panel.

2. Color: Match Glazed Aluminum Curtainwall in coil coat version, as specified in Section 08 44 13

PART 3 – EXECUTION

3.1 EXAMINATION

A. Supporting Steel Frame: Support members shall be installed within the following tolerances:

1. Plus or minus 1/8 inch in 5 feet in any direction along plane of framing.

2. Plus or minus ¼ inch cumulative in 20 feet in any direction along plane of framing.

3. Plus or minus ½ inch from framing plane on any elevation.

4. Plumb or level within 1/8 inch at all changes of transverse for performed corner panel applications.

5. Verify that bearing support has been provided behind vertical joints of horizontal panel systems and vertical joints of horizontal panel systems. Width of support shall be as recommended by manufacturer.

B. Provide field measurements to manufacturer as required to achieve proper fit of the metal wall panels to building envelope. Measurements shall be provided SUCH THAT that there is no impact to construction or manufacturing schedule.

3.2 INSTALLATION

A. Install grille and screen panels in accordance with manufacturer's installation guidelines and recommendations.

B. Install panels plumb, level, and true-to-line to dimensions and layout indicated on approved shop drawings.

C. Cutting and fitting of panels shall be neat, square and true. Torch cutting is prohibited.

D. Fasten panels securely to structure. Separate dissimilar metals and use gasketed fasteners, isolation shim, or isolation tape to eliminate possibility of corrosive or electrolytic action between metals.

E. Place trim and trim fasteners only as indicated per details on the approved shop drawings.

3.3 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, immediately following installation, unless otherwise indicated in manufacturer's written installation instructions. Maintain in a clean condition during construction.

B. Protect installed panels against damage to finish and structure by subsequent construction activities. Replace panels and framing members that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes hydraulic, stationary, loading dock lifts and control stations.

B. Related Requirements:

1. Section 03 33 00 – Cast-In-Place Concrete: Docks and pits.
2. Section 05 50 00 – Metal Fabrications: Embeds for pit edge.
3. Divisions 26 – Electrical: Electrical service for dock levelers.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI MH30.1 – Industrial Loading Dock Boards (Ramps).
2. ANSI MH29.1 – Industrial Scissor Lifts.
3. ANSI MH 30.3 – Vehicle Restraining Devices (Safety, Performance and Testing).

1.3 SUBMITTALS

A. Product Data: Manufacturer's specifications, catalog cuts, standard details, performance data, and installation instructions.

B. Shop Drawings:

1. Indicate required opening dimensions, tolerances of opening dimensions, placement dimensions and perimeter conditions of construction.
2. Wiring diagrams including location of control stations and disconnect switches.

C. Maintenance and Operating Instructions: Detailed operating, servicing, inspection, cleaning, and maintenance instructions.

1.4 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.5 QUALITY ASSURANCE

A. Stationary lifts shall conform to requirements of ANSI MH30.1

B. Vehicle restraining devices shall conform to requirements of ANSI MH30.3.

C. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years' experience.

D. Installer: Company specializing in performing work of this section with minimum five years' experience.

1.6 PRODUCT HANDLING

A. General: Protect items from damage at factory, in transit, and after installation.

1.7 FIELD CONDITIONS

A. Verify actual dimensions of construction contiguous with stationary loading dock equipment, including recessed pit dimensions, by field measurements before fabrication.

1.8 WARRANTIES

A. Manufacturer agrees to repair or replace stationary lifts that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.

2. Faulty operation of operators, control system, or hardware.

3. Deck plate failures including cracked plate or permanent deformation in excess of 1/4 inch between deck supports.

4. Hydraulic system failures including failure of hydraulic seals and cylinders.

B. Warranty Period for Structural Assembly: 10 years from date of Substantial Completion.

C. Warranty Period for Hydraulic System: 4 years from date of Substantial Completion.

D. Warranty shall be for unlimited usage of lift for the specified rated capacity over the term of the warranty.

PART 2 – PRODUCTS

2.1 STATIONARY DOCK LIFT

A. Product Description: Stationary, scissors-type, single-leg, hydraulic dock lift of capacity, size, and construction indicated; complete with controls, safety devices, and accessories required.

B. Manufacturers: Products of Advance Lifts, Inc. or compliant, approved equal.

C. Model: T-50608 Pit Mounted Dock Lift.

D. Rated Capacity: As determined in accordance with MH 29.1. Not less than 5,000 pounds.

E. Platform: Nonskid, safety-tread heavy steel deck plate.

1. Platform Size: 72 inches wide by 96 inches long.

2. Guarding: Bevel toe guards to comply with MH 29.1

3. Steel guard rails on two sides of platform with a single, removable chain across each end. Provide guard rails not less than 39 inches high with midrail and 4-inch high kickplate at bottom.

F. Hydraulic Operating System: Self-contained, electric, hydraulic power unit for raising and lowering lift; of size, type, and operation needed for capacity of lift indicated; controlled from a remotely located push-button station.

1. Remote-Control Station: Multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6 box. Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.

G. Finish: Manufacturer’s standard baked-on factory finish unless otherwise indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Requirements: Verification of existing conditions before starting work.

B. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

3.2 INSTALLATION

A. Install stationary lift in prepared opening in accordance with manufacturer’s instructions. Use mechanics skilled in Work involved.

B. Set square and level.

C. Anchor unit securely, flush with pit. Touch up welds with matching paint.

3.4 ADJUSTING AND CLEANING

A. Adjust installed unit for smooth and balanced operation.

B. Leave installation properly operating, clean, and free from defects.

3.5 DEMONSTRATION AND TRAINING

A. Demonstrate operation and maintenance requirements to Owner's personnel.

END OF SECTION

SECTION 11 24 23 - FAÇADE ACCESS EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. These performance specifications shall be read in conjunction with the Façade Access drawings that are part of the construction documentation for this trade package, specifically sheets with “FA” prefix.

B. Provide all design, engineering, materials, manufacturing, and installation labor required to deliver a complete EBM and Façade Access system necessary to provide access to all façade elements outlined on the Façade Access drawings.

2. DOCUMENTATION

a. Original Equipment Manufacturer (OEM) Operations and Maintenance (O&M) Manuals
b. Demonstration of equipment

1.2 WORK EXCLUDED

A. The following are regulatory and operational project requirements not included in this section:

1. Guardrail systems.
2. Fixed ladders and other related access equipment.
3. Electronic two-way communication devices.
4. Electrical power receptacles and wiring as identified on drawings.
5. Water supply hose bibs as identified on drawings.
6. Waterproofing, flashings, etc.
7. Reinforcing of the building structure.
8. Operating Procedures Outline Sheet (OPOS).

1.3 RELATED SECTIONS

A. Division 1 General Requirements
B. Division 3 Concrete
C. Division 5 Metals

1.4 REGULATORY COMPLIANCE

A. All design, engineering, materials, equipment, system performance, inspection, and testing, use and written work product to comply with and be performed in compliance with the following applicable regulatory codes and standards. Special consideration shall be given to procuring the most recent revision of said codes and standards. This is in addition to any other pertinent local, state, and federal requirements having jurisdiction. Any conflicting codes or standards affecting this work shall be presented to the Project Consultant for determination and course of action.

1. California Code of Regulations, Title 8, GISO, Article 5
2. California Code of Regulations, Title 8, GISO, Article 6

3. American National Standards Institute (ANSI) / IWCA I-14.1 Window Cleaning Safety Standard
4. Federal Occupational Safety and Health Act (OSHA): OSHA Part 1910, paragraph 1910.66 “Power Platforms for Building Maintenance.”
5. Federal Occupational Safety and Health Act (OSHA): OSHA Part 1910, Subpart D “Walking-Working Surfaces.”
6. American Society of Mechanical Engineers (ASME) / ANSI A120.1 “Safety Requirements for Powered Platforms for Building Maintenance”
7. American National Standards Institute (ANSI) / SAIA A92.6 “American National Standard for Self-Propelled Elevating Work Platforms”
8. American National Standards Institute (ANSI) / ASSE Z359 “Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components”
9. American Institute of Steel Construction (AISC): AISC “Load and Resistance Factor Design Specification for Structural Steel Buildings”
10. American Welding Society (AWS): D1.1 “Structural Welding Code, Steel”

1.5 SUBMITTALS

A. Prior to fabricating and construction, submit the following to the General Contractor for review and approval:

1. Equipment/Materials List: Complete equipment and materials listing, with quantities) of all items proposed for this project.
2. Product Data: Manufacturer specifications and product data sheets of all standard or typical components proposed. The compliance with paragraph 1.4 of this specification is to be clearly noted on all manufacturer specifications and product data sheets.
3. Shop Drawings: Scaled shop drawings showing the layout, details, sections, rigging procedure, drop sequence and related operating procedures. The following shall be included in the shop drawings:

    a. Consideration of any potential physical and operational conflicts with the architectural design elements and with all other division trade work installations and systems as well as proposed resolution/coordination of such conflicts.
    b. Equipment layout plan, elevations, details, and sections which clearly illustrate the equipment installation location and methods as well as the rigging procedures and drop sequence that demonstrate an operation system without conflicts with current project conditions, façade elements, site work, etc.
    c. Identification of all equipment component materials, dimensions, sizes, arrangements, thicknesses, finishes, and other data to clearly illustrate the equipment being installed.
    d. Required load capacities of the building structure to which all equipment installations are proposed are to be clearly illustrated for consideration and review of the overall project Structural Engineer.
    e. Identification of “other trade” work designations including but not limited to electrical power requirements and locations of receptacle and water supply hose bib locations.
    f. Professional Engineer wet stamp and signature by a Professional Engineer with a minimum of 5 years of experience in designing window cleaning and related façade access equipment and licensed/registered in the state where the Project is located.

4. Structural Calculations: To be executed on all equipment and components for this Project by a Professional Engineer licensed/registered in the state where the Project is located. The

Professional Engineer must have a minimum of 5 years of experience in designing window cleaning and related façade access equipment.

5. Welding Certification: Demonstrating that all field and shop welding complies with the AWS D1.1 and performed by AWS Certified Welder.

B. After fabrication and construction, submit the following to the General Contractor for review and approval:

1. Test results from all Inspections and Tests conducted per paragraph 3.3.
2. Equipment Warranty: Three (3) copies
3. Operation and Maintenance Manual: Three (3) copies, labeled, bound, and neatly illustrated documenting the operation and maintenance of the “specific” equipment installed on this Project. Minimum manual requirements are as follows:

    a. Table of Contents
    b. Manufacturer
    c. Equipment Inventory complete with location and serial numbers.
    d. Warnings and Notices.
    e. Illustration of Labels and Notices affixed to permanent and portable equipment.
    f. Inspection Check List (Periodic and Maintenance Inspections).
    g. Inspection Log (Periodic, Maintenance, Daily).
    h. Maintenance procedures.
    i. Operating procedures.
    j. Troubleshooting.
    k. Rescue Plan.
    l. Rigging Access Plan.
    m. Warranty in triplicate.

4. Certificate of Regulation Compliance

1.6 QUALITY ASSURANCE

A. California Projects: All equipment is to be manufactured and installed by a manufacturer or contractor possessing a current and valid Scaffold Inspection and Testing Agency (SIT) designation by the California Department of Industrial Relations, Division of Occupational Safety and Health.
B. Engineer Qualifications: Registered Professional Engineer licensed to practice in the jurisdiction where the Project is located possessing a minimum of 5 years’ experience in designing building maintenance, façade access and related fall protection equipment. Per CCR T8 GISO 3294(a)(1) and 3295(a)(1) the engineer shall be “experienced in such design”
C. Manufacturer Qualifications: Manufacturer’s primary trade is the design and manufacturing of window cleaning and related façade access equipment and has been actively engaged in this business for not less than 10 years.
D. Contractor/Installer Qualifications: Installer is required to be employed by manufacturer or provide written approval from manufacturer to install its products.
E. Welder Qualifications: AWS certified within the last 12 months for each type of weld required.
F. Regulatory Compliance: Refer to paragraph 1.4

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements in Section 01 60 00.

B. Deliver all equipment and material to the project properly packaged according to the manufacturer's packaging requirements in sizes as large as practical.
C. Store materials under cover in a dry and clean location off the ground.
D. Damaged or faulty equipment or materials are to be removed from the project and replaced with acceptable equipment or materials.

1.8 WARRANTY

A. Provide Manufacturer's Warranty for a period of three (3) year(s) to cover the following:

1. Material defects.
2. Workmanship.
3. Installation (self-performed)
4. Installation (by other trades)
5. Certification clause of adherence to paragraph 1.4 (Regulatory Compliance)

B. Warranty to be submitted on original certificated document. Three (3) originals to contain wet signatures by the authorizing party.

PART 2 - PRODUCTS

2.1 CONTRACTORS / INSTALLERS

A. Contractor / Installer Qualifications:

1. Installer is required to be employed by manufacturer or provide written approval from manufacturer to install its products and have a minimum of 5 years' experience in the installation of this and related equipment.

2.2 DESIGN REQUIREMENTS

A. The complete Building Maintenance Equipment system including individual components and overall functionality is to be designed by or under the direction of a Professional Engineer registered in the state where the project is located. Duties and responsibilities include verification that all components supplied comply with the applicable portions of paragraph 1.4 above.

B. In addition to compliance with the design requirements of the various regulatory standards cited in paragraph 1.4, special attention shall be given to the following:

1. All loads transferred to the building structure by the equipment in this section are to be clearly called out on the drawings and calculations and submitted for review to the overall Project Structural Engineer for review and consideration of any required additional reinforcing of the structure.
2. A minimum safety factor of four (4) is to be designed into all equipment in this section. Exceptions to this are the following:

    a. Suspension Wire Rope: the minimum safety factor shall be ten (10).
    b. Tie-Back Anchors: 5000-pound anchorage and assembly strength for loads applied in any direction without any permanent deflection.
    c. Horizontal / Catenary Lines: the minimum safety factor shall be two (2).

3. All parapets or building component upon which safety line are resting to be designed with consideration of the dynamic loading from the potential shock loading of a fall arrest incident.

2.3 GENERAL REQUIREMENTS

A. Corrosion Resistance:

1. All structural steel components and assemblies are to be hot dipped galvanized prior to final assembly according to the applicable ASTM standard specification for the particular steel, component, or assembly. These standards include but are not limited to ASTM A123 / A123M -13 (structural steel) ad ASTM A123 (hardware).
2. When it is necessary to breach the hot dipped galvanized finish of steel components due to welding or machining, the standard practice for repair of damaged and uncoated areas of hot dipped galvanized coatings found in ASTM A780 / A780M -09 shall be adhered to.
3. Vent holes in steel components required for the galvanization process shall be permanently sealed to prevent accumulation of moisture from condensation.

B. Hardware and Fasteners:

1. All hardware and fasteners shall be comprised of materials suitable for their application, considering dissimilar base and clamping materials. Isolators, when required due to conditions presented by the base and clamping materials, shall be used to prevent bimetallic or galvanic corrosion. At minimum, the following criteria shall apply to all fasteners:

    a. All hardware, fasteners, and their accessories, including springs and rivets, shall be comprised of austenitic stainless steel. Exception: hot dipped galvanized fasteners embedded in concrete or used to make connections between other hot dipped galvanized base and clamping materials.
    b. All threaded fastening assemblies including bolted connections and studs shall be provided with a mechanical means to stop the nut from unintentionally backing out.

2.4 COMPONENTS AND EQUIPMENT

A. Pedestals: Furnish and install the appropriate number of pedestal assemblies for each type of portable socket assembly required by the application at the specific roof level and elevation that are designed, engineered, and fabricated to the standards and regulations cited in this specification including but not limited to the following:

1. Pedestals shall be designed, fabricated, and installed with the top plate level and plumb.
2. The distance of the davit pedestal to the finished roof shall be no less than 4” and no more than 10”. Consideration shall be given to the sloping of the roofing system.

B. Tie-Back Anchors: Furnish and install Tie-Back Anchors that are designed, engineered, and fabricated to the standards and regulations cited in this specification including but not limited to the following:

1. Anchor loop to be designed for a minimum of 5000# factored load applied in any direction of the attachment point without any permanent deflection.
2. The inside minimum diameter of all anchor loops or attachment shall be no less than 2”.

C. Davits: Furnish and install permanent davits that are designed, engineered, and fabricated to the standards and regulations cited in this specification including but not limited to the following:

1. The davit boom/bracket section is to be top or bottom rotating.
2. The overall length of the boom section shall not be more than that required to position the centerline of the wire rope hang point at no more 20” from the outer most face of the building façade elements and/or as limited or shown in the Façade Access drawings.
3. Accurately machined components complete with rollers and/or nylon sliders required to provide for the extension and retraction of the boom section.
4. Each davit is to be designed for F-Type suspended platforms or 2-point suspended powered bosuns or work baskets.
5. All davits shall be provided with a rating plate bearing the manufacturer’s name, a high voltage warning prohibiting use near power lines, the davits rated load, and the davits total assembled weight.
6. Any davit component weighing more than 80 pounds shall be provided with a means to transport the component from location to location. Such means shall maintain the center of gravity required to prevent the component from overturning during transport
7. Any complete davit assembly weighing more than 140 pounds shall be provided with a mechanical means to lift the davit into position.
8. All wheels used in transport assemblies incorporated into or provided with this equipment shall have solid rubber wheels. Pneumatic wheels will not be accepted.

D. Portable Sockets: Furnish and install the appropriate number of portable socket assemblies for each type of davit required by the application at the specific roof level and elevation that are designed, engineered, and fabricated to the standards and regulations cited in this specification including but not limited to the following:

1. Portable sockets shall be designed to provide plumb davit working conditions.
2. All portable socket assemblies shall be provided with pivoting sockets that will allow the insertion or removal of a davit at a position of not more than 35 degrees above the horizontal roof.
3. The portable socket shall allow for the complete davit assembly to be inboard of the building face being served while being raised and lowered.
4. The portable socket assembly shall be provided with a means to positively lock the davit assembly to the socket assembly while in operation.
5. The portable socket assembly shall be provided with a means to positively lock this assembly to the permanent pedestal while in operation.
6. All portable socket assemblies shall be designed with wheels to allow ready movement from pedestal to pedestal.
7. All portable sockets shall not require lifting to mate with the pedestal. Consideration shall be given to the sloping of the roofing system.
8. All wheels used in transport assemblies incorporated into or provided with this equipment shall have solid rubber wheels. Pneumatic wheels will not be accepted.
9. Any safety line tieback anchors incorporated into the portable socket assembly shall engineered to provide a minimum of 5000# load capacity independently and as part of the overall davit, socket, and pedestal assembly.

PART 3 – EXECUTION

3.1 EXAMINATION

A. All affected and affecting work areas, installations, etc. shall be examined to ensure physical conditions and other related conditions are adequate for the subsequent installation.

B. Consideration of any potential physical and operational conflicts with the architectural design elements and with all other division trade work installations and systems shall be made as well as proposed resolution/coordination of such conflicts be developed.

3.2 INSTALLATION

A. All installations shall be performed in accordance with all original design drawings, shop drawings, approved submittals, manufacturer specifications and applicable regulatory governmental compliance.

B. Coordination with other division trade work installations is mandatory.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections: The following inspections and tests shall be conducted on components and installed equipment to ensure compliance with this specification and full operational functionality of the overall system. Any material, equipment functionality and operational deficiencies noted as a result of these inspections and tests shall be corrected and reinspected/tested to verify compliance with this specification.

1. All inspection criteria, operational testing procedures and load test prescriptions to be obtained by the original equipment manufacturer, in writing, prior the conduction any of the following tests.
2. Tie-Back Anchors: Each loop to be tested in a manner as prescribed by the manufacturer to a load no less than 50% of its design load capacity but no more than 2500 pounds.
3. Suspension Equipment (Davits, Outriggers, Carriages, etc.): Full live load and operational tests under the maximum live loading conditions over the complete range of the overall system.
4. Suspended Equipment: Verify the dead (self) weight of the platform. The OEM design engineer is responsible for issuing a Certificate of Regulation Compliance as per the paragraph 3.4 of this specification.

B. All test results shall be recorded and submitted according to paragraph 1.5.

3.4 CERTIFICATION

A. Provide a written Certificate of Regulation Compliance for all components and equipment installed under this specification certifying the following:

1. All components and equipment have been manufactured and installed according to all Project regulations and applicable regulatory jurisdiction.
2. The components and equipment have been inspected and tested according to the provisions in paragraph 3.3 and have successfully passed.
3. The system is operational and ready for owner turnover.
4. Certificate of Regulation Compliance to be dated and signed by a registered professional engineer representative of the contractor/manufacturer.

3.5 DEMONSTRATION

A. Only once the complete system has been installed, inspected, and tested, and a Certificate of Compliance has been issued, a demonstration of said equipment is to be arranged with the General Contractor and Owner at a time that is mutually agreeable. The following conditions shall apply to the demonstration of the equipment:

    1. The demonstration event shall not be used to satisfy the requirements of part 3.3 of this specification.
    2. The demonstration shall include, but is not limited to, the following:

        a. One functional demonstration of each type of equipment at every unique building/rigging condition where that type of equipment occurs.
        b. Instruction, as needed, shall be provided to Owner representatives during the demonstration.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes residential appliances indicated.

B. Related Sections:

1. Division 22 – Plumbing.
2. Division 26 – Equipment Wiring Connections.

1.2 REFERENCES

A. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.

B. Underwriters Laboratories Inc.:

1. UL - Electrical Appliance and Utilization Equipment Directory.

1.3 SUBMITTALS

A. Submit following items under provisions of Division 1.

B. Product Data: Submit data on equipment and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit relevant instructions.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified with minimum five years' experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver materials in manufacturer's packaging; include installation instructions.

C. Inspection: Accept appliances on-Site. Inspect for damage.

D. Store appliances according to manufacturer's instructions.

PART 2 – PRODUCTS

2.1 RESIDENTIAL KITCHEN APPLIANCES

A. General: Furnish all kitchen appliances from a single manufacturer. Maytag models are listed as the basis of the specification.

B. Refrigerator/Freezer – Full-Height: Free-standing, one-door style with frost-free bottom-freezer and filtered ice-maker. Reversible hinge. Finish: Stainless. Energy Star qualified. Nominally 70”x33”x33” (HxWxD). Maytag “MBF2258FEZ” or approved equal.

C. Microwave Oven: Large capacity, built-in over-range type, with convection cooking function. 1000 watt. Finish: Stainless. Nominally 17”x30”x16” (HxWxD) and 1.9 cu ft compartment. Maytag Model “MMV6190FZ” or approved equal.

D. Dishwasher: Integrated dishwasher, ADA compliant. Finish: Stainless. Nominally 34”x24”x24” (HxWxD). Maytag Model No. “MDB4949SKZ” or approved equal.

2.2 LAUNDRY APPLIANCES

A. General: Furnish washer and dryer as a matching set. Maytag models are listed as the Basis of the Specification.

B. Front-Load Washer: 3 cubic foot capacity. Energy Star rated. Nominally 38”x27”x29” (HxWxD). Maytag Model No. “MHN33PR”.

C. Front-Load Dryer: Electric. 6.7 cubic foot capacity. Energy Star rated. Nominally 39”x27”x29” (HxWxD). Maytag Model No. “MDE23PR”.

2.3 MISCELLANEOUS APPLIANCES

A. Food Disposal: Continuous feed, 1/2-HP motor, galvanized steel grinding elements with two stainless steel 360º swivel lugs. Insinkerator “Badger 5” or approved equal.

~~B. Coffee Machine: Built-in, plumbed. Coffee, espresso, tea functions. Coffee and teapots included. Finish: Stainless. Thermador Model “TCM24PS” or approved equal.~~

PART 3 – EXECUTION

3.1 EXAMINATION

A. Division 1 – Administrative Procedures: Coordination and project conditions.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

C. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

E. Install gas appliances according to requirements of NFPA 54.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.

2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After installation, start units to confirm proper operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspection.

3.4 PROTECTION

A. Division 1 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Do not permit operation of appliances, other than for testing, prior to Substantial Completion.

END OF SECTION

PART 1- GENERAL

1.1 SUMMARY

A. Section Includes manually-operated roller shades with single rollers.

B. Related Sections:

1) Section 06 10 53 - Rough Carpentry for wood blocking and grounds for mounting roller shades and accessories.
2) Section 07 92 00 - Joint Sealants for sealing the perimeters of installation accessories for light-blocking shades with a sealant.
3) ~~Section 09 22 16 "Non-structural Metal Framing" for metal backing plates for mounting roller shades and accessories.~~
4) Section 09 21 16 – Gypsum Board Assemblies for Backing Plates and other coordination with gypsum board assemblies for installation of shade pockets, closures and related accessories.
5) Section 09 51 00 - Suspended Panel Ceiling Systems: Coordination with suspended ceiling assemblies.

1.2 REFERENCES

A. ASTM International (ASTM):

1) ASTM G 21: Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. National Fire Protection Association (NFPA):

1) NFPA 701: Fire Tests for Flame-Resistant Textiles and Films, Small Scale Test.

1.3 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use. Material shall also be washable, dimensionally stable and U.V. resistant.

B. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

C. Maximum Allowable Roller Deflection: L/700 for the clear span from roller to bottom of window shade, when fully extended.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1) Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
2) Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

B. Plan drawings showing location of each shade.

1) Details of all shade types.

C. Samples for Verification: For each type of roller shade.

1) Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2) Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3) Installation Accessories: Full-size unit, not less than 10 inches long.

D. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material, signed by product manufacturer.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Obtain all roller shade system components through single manufacturer source.

B. Qualified Installer: Installer trained and certified by the manufacturer with a minimum of five years' experience in installing products comparable to those specified in this section.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.7 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) Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

A. 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.

B. 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.

1.10 WARRANTIES

A. Material Warranty: Provide material manufacturer's product warranty for the durations identified below from the date of Substantial Completion.

1) Roller Shade Hardware and Chains: Twenty year.

2) Shadecloth: Ten year.

PART 2 –PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Products by MechoSystems; 42-03 35th Street, Long Island City, NY 11101. Local rep: Lyndsey Harper. Email: Lyndsey.harper@MechoSystems.com or equal.

B. Source Limitations: Obtain roller shades from single source from single manufacturer

2.2 MANUAL ROLLER SHADE SYSTEMS **(TYPE WS1A (and WS1B -AS NOTED))**

A. Product Description: Chain operated manual interior roller shade systems. Surface mountings, with fascia as shown on Drawings. Single-roll with room darkening shade cloth. MechoSystems' "Ecoveil 1550" is the basis of the specification.

B. Mounting: Minimum 1/8 inch thick steel mounting brackets, 3 inches deep by 4 inch maximum profile. Maximum 4 inch standoff from wall with wall to fascia mount angle in place. Roll up diameter capacity with fascia 2-3/4 inches minimum.

1) Shade Roll Direction: Regular roll.

C. Manual Shade Pulls: Stainless steel bead chain with breaking strength of not less than 30 lbs. Position of shade pulls shall not require notching of fascias. **Provide Lift Assist Mechanism to comply with ADA allowable pull pressures.**

D. Manual Geared Operator: Braking mechanism shall allow shade to be stopped at any desired point of travel.

E. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shades for service.

1) Roller:

a. Drive-End Location: To be reviewed in shop drawings by the Architect.
b. Direction of Shadeband Roll: Regular, from back of roller.

2) Shadeband-to-Roller Attachment:

a. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on", "snap-off" spline mounting, without having to remove shade roller from shade brackets
b. Mounting Spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
c. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

F. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

G. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

H. Shadebands, as indicated on drawings:

1) Shadeband Material: Light-filtering fabric.

a. Basis of Design is Mechoshade Ecoveil 1550. Transparency 3%
b. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2) Shadeband Bottom (Hem) Bar: Steel or extruded aluminum. Color as selected by architect.

I. Installation Accessories: ~~(For all manual shades):~~

1) TYPE WS1A: Wall mounted end brackets: with removable **3"** bottom closure panel, **with closure mount with tile support trim.**

2) TYPE WS1B: Alum Curtainwall Mullion mounted Shade Pocket: Rectangular, extruded-aluminum enclosure designed for open ceiling installation; with fascia, and back formed as one piece, end caps, and removable **3"** bottom closure panel.

~~2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recesses or pockets and for snap-in attachment to wall clip without fasteners.~~

2.3. MANUALLY OPERATED, DOUBLE-ROLLER SHADES **(TYPE: WS2)**

A. Product Description: Chain operated manual interior roller shade systems. Surface mountings, with fascia as shown on Drawings. Double-roll with Solar and Room Darkening Shadebands. MechoSystems "Ecoveil 1550" and Mechoshade 0250 Chelsea Series are the basis of the specification.

B. Mounting: Minimum 1/8 inch thick steel mounting brackets, 3 inches deep by 4 inch maximum profile. Maximum 4 inch standoff from wall with wall to fascia mount angle in place. Roll up diameter capacity with fascia 2-3/4 inches minimum.

1) Shade Roll Direction: Regular roll.

C. Manual Shade Pulls: Stainless steel bead chain with breaking strength of not less than 30 lbs. Position of shade pulls shall not require notching of fascias. Provide Lift Assist Mechanism to comply with ADA allowable pull pressures.

D. Manual Geared Operator: Braking mechanism shall allow shade to be stopped at any desired point of travel.

E. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-

end assemblies and idle-end assemblies designed to facilitate removal of shades for service.

1) Double-Roller Mounting Configuration: As indicated on Drawings.

F. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

G. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

H. Solar Shadebands, as indicated on Drawings.

1) Shadeband Material: Light-filtering fabric.

a. Basis of Design is Mechoshade Ecoveil 1550. Transparency 3%
b. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2) Shadeband Bottom (Hem) Bar: Steel or extruded aluminum

a. Type: exposed with end caps
b. Color and Finish: as selected by Architect from manufacturer's full range.

I. Room Darkening Shadebands (Single-Fabric), as indication on Drawings.

1) Shadeband Material: Blackout material.

a. Basis of Design is Mechoshade 0250 Chelsea Series, PVC Free – Polyester base with foam backing. Reverse of shade is charcoal color.
b. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2) Shadeband Bottom (Hem) Bar: Steel or extruded aluminum

a. Type: exposed with end caps
b. Color and Finish: as selected by Architect from manufacturer's full range

J. Installation Accessories:

1) Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2) Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

   a. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.
   b. Endcap Covers: To cover exposed ends.

K. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.

1) Installation Accessories Color and Finish: as selected from manufacturer's full range.

L. Roller Shade Fabrication:

1) Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

2) Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

   a. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
   b. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

M. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1) Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material:

N. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions

1) Room Darkening Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes recessed entrance floor walk-off mat systems, inclusive of frames.

B. Related Sections:

1. Section 01 81 13 – Sustainable Design Requirements.

2. Section 03 30 00 – Cast-in-Place Concrete: Recesses for floor mats and frames.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D2047 Coefficient of Friction (James Method)

2. ASTM E648 Critical Radiant Flux

3. ASTM B117 Product Corrosion to Salt

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide entrance floor mats and frames capable of withstanding a rolling wheel load of 350 lb.

B. Slip Resistance: Entrance floor mats and frames shall meet or exceed a slip resistance of 0.6 when tested in accordance with ASTM D2047.

C. Corrosion Resistance: Entrance floor mats and frames shall be tested in accordance with ASTM B117, with no notable change in appearance after 100 hours.

1.4 SUBMITTALS

A. Product Data: Include material descriptions, dimensions of individual components and profiles, product performance, and finishes for each type of product to be furnished. If required, furnish manufacturer's standard colors for selection.

B. Shop Drawings: Show any divisions between mat sections, and frame relationship to floor recess.

C. Samples: Submit assembled sections of floor mat with each type of tread rail and frame members in each type and color to be furnished, no larger than 8 inches by 8 inches.

D. Sustainable Design Submittals: Section 01 81 13 Sustainable Design Requirements.

1. Materials Resources Certificate: Certify recycled material content for recycled content products.

2. Indoor Environmental Quality Certificates: Certify volatile organic compound content for each interior flooring system and adhesive.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver components in manufacturer's original, unopened factory packages labeled to indicate contents. Store and handle materials in safe, dry area fully-protected from weather and in accordance with manufacturer's instructions.

1.6 WARRANTY

A. Provide five (5) year written manufacturer product warranty agreeing to repair or replace units, which fail in materials or workmanship, including fading or other deterioration of finishes which exceeds that of normal wear and tear.

B. Provide two (2) year written installation warranty signed by installer, agreeing to repair or replace units that do not maintain flush, rigid installation devoid of rocking, shifting or deflection under normal loading conditions.

PART 2 – PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES

A. Manufacturers: Furnish compliant products of one of the following or approved equal:

1. Babcock-Davis.
2. Construction Specialties.
3. Forbo Flooring.
4. Mats Inc.
5. Pawling Corporation.

B. Product Description: Recessed grid and mat assemblies consisting of extruded aluminum tread rails alternating with tread inserts, joined together with bolt-through system and aluminum spacers. Assembly shall facilitate the drainage of water and facilitate cleaning. Basis of Specification: Mats Inc "Advance Track" with style "AD" angle frame.

1. Frames: 6061-T6 aluminum alloy with 1-5/8 inch total depth.
2. Tread Inserts: Manufacturer's premium nylon in standard Gray color.
3. Scraping Rails: 6063-T5 aluminum alloy.
4. Colors, Textures and Patterns of Inserts: As selected by Architect from among manufacturer's standard.
5. Rail and Frame Color: Clear Anodized.
6. Mat Size: As indicated on Drawings.

7. Accessories: Furnish each grid section with stainless steel hinges and galvanized steel key lock-downs.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Division 1 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content, and with no less than that required in Section 01 81 13.

2.3 CONCRETE GROUT MATERIAL

A. Provide concrete grout material equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.4 FABRICATION

A. Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Shop fabricate frames for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

C. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames. Ensure that concrete floor recesses are adequate to properly install and level product.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed mat frames and mats to comply with manufacturer's written instructions so that tops of mats will be flush with adjoining finished flooring. Set mats with tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.

1. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

2. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION

PART 1 – GENERAL

1.1 Summary

A. This section includes specifications for the sliding hook bike file rack.

1. Bikes parked per unit: 7 bikes per 6’-6” foot unit.

1.2 Quality Assurance

A. Installer Qualifications: An experienced installer who has completed installation of bicycle racks similar in material, design, and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing bicycle racks similar to those required for this project and with a record of successful in-service performance.

C. Source Limitations: Obtain each color, finish, shape and type of bicycle rack from a single source with resources to provide components of consistent quality in appearance and physical properties.

D. Product Options: Drawings indicate size, shape and dimensional requirements of bicycle racks and are based on the specific system indicated.

1.3 Submittals

A. Product Data: Include physical characteristics such as shape, dimensions, bicycle, material parking capacity and finish for each bicycle rack.

B. Shop Drawings: Show installation details for each bicycle rack.

C. Samples for Verification: Submit finish samples for review and verification.

D. Maintenance Data: For each bicycle rack.

1. Include recommended methods for repairing damage to the finish.

1.4 Delivery, Storage and Handling

A. Upon delivery, before signing for shipment, inspect for any damages and notate on the B.O.L.

B. Store bicycle racks in original undamaged packages and containers until ready for installation. Handle bicycle racks with sufficient care to prevent any scratches or damage to the finish.

1.5 Warranty

A. Bicycle racks carry a one year manufacturer’s limited warranty against defects in materials and workmanship. The one year warranty period begins the date the product is shipped from the manufacturer.

PART 2 – PRODUCTS

2.1 Acceptable Manufacturers

A. Provide bicycle racks manufactured by Southwest Solutions Group, 2353-B E. State

Highway 121, Ste. 110, Lewisville, TX 75056, 1-800-803-1083

Website: www.southwestsolutions.com

2.2 Materials

A. 12 gauge galvanized steel trolley track, stainless steel trolley assembly, 1” 16g arms.

B. Installation Methods: Wall mounted, ceiling mounted, and floor mounted models are available.

2.3 Finishes

A. All frame components are zinc-plated and trolleys are stainless steel.

2.4 Bike File

A. Setbacks

1. Wall Setback: 0”
2. Distance Between Racks: Bike Files may be connected in a series to make one system. One unit is 96” long.
3. Aisle: The aisle should start 50” from the wall or back of Bike File and be 36” wide.

B. Racks

1. Wall mount: The wall mounted Bike File may be mounted to walls that will support the weight of a Bike File that is fully loaded with bikes.

PART 3 – EXECUTION

3.1 Installation

A. Installation Method

1. Wall mount
2. Ceiling mount
3. Floor mount
4. It is the responsibility of the installer to ensure that all base materials into which the rack will be installed can support the rack and will not be damaged by any required installation procedures.

3.2 Ordering Information

A. When ordering or specifying this rack, make sure the product type, size, and fastener type (if applicable) are included. Contact your Southwest Solutions Group representative for a current price list or to place an order.

3.3 Freight

A. Call 1-800-803-1083 for freight quotes.

END OF SECTION

SECTION 142150
GEARLESS MACHINE ROOM LESS TRACTION ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes two gearless machine-room-less (MRL) traction passenger elevators, Cars 1 and 2.

B. Products Installed but Not Furnished Under This Section:
   1. Camera provisions. Section 28 23 00, Refer to Security Drawings.
   2. Elevator security devices, control unit, mounting brackets, wiring materials, logic circuits, security system interface terminals, boxes, and relays. Section 28 13 00, Coordinate with Security Vendor.
   3. Car interior finishes.
   4. Car flooring.
   5. Monitoring system interface. Section 28 31 00.

1.2 ALTERNATES

A. Refer to Division 01 section “Alternates” for requirements and procedures for acceptance.

B. Detailed description of Alternates for work of this section are included in Part 2.7.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Include capacities, sizes, performance data, operation, control, signal systems operation, safety features, finishes, and similar information.
   2. Include product data for car enclosures and hoistway entrances.
   3. Include product data for signal fixtures, lights, graphics, Tactile marking plates, and details of mounting.

B. Shop Drawings: Provide scaled shop drawings of the following:
   1. Plan and section layouts of hoistways, pits, overheads, machinery spaces and openings at each landing, to include the following:
      a. Location of all equipment.
      b. Static and dynamic loads imposed on building structure.
      c. Details of equipment isolation.
      d. Required clearances around equipment.
      e. Control room and machine heat release.
      f. Provide heat loads based on a regenerative emergency power operation.
      g. Power Requirements:
         1) Motor horsepower, code letter, starting current, full load running current, and demand factor.
         2) Provide maximum and average power consumption.
      h. Service connections.

i. Running Clearances.
j. Location of fixtures.

2. Elevation Section of Hoistways:
   a. Overhead, pits: clearances, and runby.
   b. Entrance details.
   c. Sill support detail.
3. Pit Equipment:
   a. Buffers.
   b. Counterweight guards.
   c. Pit reactions.
   d. Service ladder, platform.
   e. Stop switches.
4. Elevator Cabs:
   a. Car shell fabrication.
   b. Gasketing.
   c. Ventilation.
   d. Ceiling construction details.
   e. Wall construction details.
   f. Lighting details.
   g. Handrail mounting details.
   h. Transom, entrance returns.
5. Fixtures:
   a. Car operating panel.
   b. Hall stations.
   c. Destination/landing input stations.
   d. Hall Lanterns.
   e. Position indicators.
   f. Access key switches.
   g. Remote fixtures.
      1) Firefighter's control panel.
      2) Emergency power selector switches.
   h. Two-way communication device at all master stations.

C. Submittals:
   1. All submittals are delivered via Portable Document Format (.pdf)
   2. All submittals are clearly marked and identified with project name and appropriate device identification.
   3. All submittals are subject to approval.
   4. Corrections requested are incorporated onto the submittals.
   5. All shop drawings submitted must be signed and sealed by an Engineer licensed in the state where the elevator system will be installed.

D. Samples for Initial Selection: For finishes involving surface treatment, paint or color selection.

E. Samples for Verification:
   1. For exposed car, hoistway door and frame, and signal equipment finishes.
   2. Samples of sheet materials: 3" (75 mm) square.
   3. Running trim members: 4" (100 mm) lengths.

4. Include full component samples, if requested:
    a. Signal fixtures
    b. Lighting
    c. Graphics
    d. Tactile markings

1.4 CLOSEOUT SUBMITTALS

A. Continuing Maintenance Proposal:
1. Submit executed Installer's Two-year maintenance agreement, starting at the end of the warranty maintenance period.
2. State services, obligations, conditions, and terms for agreement period and for future renewal options.

B. Record Documents: The following record documents are furnished upon completion and before final payment and delivered via Portable Document Format (.pdf):
1. Shop Drawings:
    a. Complete sets of as installed plan and section layouts of hoistways, pits, overheads, and equipment spaces, to include the following:
        a) Static and dynamic loads imposed on building structure.
        b) Details of equipment isolation.
        c) Required clearances around equipment.
        d) Control room heat release.
        e) Power requirements.
    b. Elevation Section of Hoistways: Overhead, pits, and entrance details.
    c. Elevator cabs.
    d. Fixtures:
        1) Car fixtures.
        2) Hall fixtures.
        3) Remote fixtures.
    e. Control room heat release and power requirements.
2. Wiring Diagrams:
    a. Complete sets of as installed straight-line wiring diagrams, showing the electrical connections of all altered vertical transportation equipment, are furnished upon completion.
    b. A legend sheet is furnished with each set of drawings containing the following information:
        1) Name and symbol of each relay, switch and other electrical or solid-state apparatus.
        2) Location on drawings, drawing sheets, number and area of switches and relays, and location of all contacts.
        3) Location of apparatus whether on controller, in hoistway or on elevator cab.
3. Maintenance and Operating Manuals:
    a. Description and sequence of operation of all equipment installed, including operating use for Building Personnel and tenants, as well as system troubleshooting manuals for technicians.
    b. Maintenance instructions and procedures of all vertical transportation equipment installed, including parts lists, for each elevator system.

c. Lubrication charts indicating all lubricating points and type of lubricant recommended for all equipment.
d. Complete parts catalogs for all replaceable parts.

C. Tools: The following equipment is furnished upon completion and before final payment:
1. The Elevator Contractor provides all the necessary tools, including laptop, hand-held devices, required software and manuals, required to troubleshoot, adjust, synchronize, calibrate, repair, and maintain the vertical transportation systems, as well as perform all necessary procedures to perform all safety tests as required by code and local governing authority.
2. Owner's equipment and software is updated regularly to properly troubleshoot, adjust, synchronize, calibrate, repair, maintain and test the vertical transportation systems. All equipment and/or software is of the same version as issued to technicians maintaining the vertical transportation systems.
3. The Elevator Contractor provides a backup copy of any software that resides on the troubleshooting tool.
4. Upon cancellation of service agreement, the Elevator Contractor provides all updates indicated above.

D. Keys:
1. Four sets of keys to operate all keyed switches and locks are furnished upon completion.
2. Keys properly tagged.
3. All keying arranged with the Contractor.

1.5 PERMITS, TESTS, AND CERTIFICATES

A. Permits:
1. The Elevator Contractor secures the permits required for work to be performed, including work of sub-contractors.
2. The Elevator Contractor obtains and pays for all municipal and state permits necessary for execution of the elevator work, including fees for renewing permits.
3. The Elevator Contractor is responsible for posting all permits as required by the AHJ.
4. The Elevator Contractor is responsible for obtaining final sign-off and approval for each permit.

B. Tests and Inspections:
1. The Elevator Contractor performs all necessary tests as required by ASME A17.1 and recommended by A17.2.
2. The Elevator Contractor is responsible for scheduling the necessary tests as required by the local authorities. Any fees associated with a missed appointment, or for expediting of test or overtime tests due to delays caused by the Elevator Contractor are the responsibility of the Elevator Contractor.

C. Certificates:
1. Elevator Contractor is responsible for obtaining and providing Contractor with all temporary and final inspection certificates of the proper governing authorities and provides the Contractor with such certificates.

2. The Elevator Contractor pays for all fees necessary for obtaining temporary and final inspection certificates.

1.6 QUALITY ASSURANCE

A. Compliance with Regulatory Agencies: Comply with most stringent provisions of codes, laws, and/or authorities, including revisions and changes in effect.

B. Progress Reviews:
1. The Elevator Contractor is subject to reviews by the Consultant and/or Contractor at any time throughout the project.
2. Contractor to assist without additional cost.

1.7 DELIVERY, STORAGE, AND HOISTING

A. General:
1. The protection of all equipment and exposed finishes is the responsibility of the Elevator Contractor during delivery, handling, and installation until final acceptance of elevator equipment.
2. The Elevator Contractor replaces damaged materials with new, at no additional cost for material and labor.

B. Delivery and Storage:
1. It is the responsibility of the Elevator Contractor to properly store and protect all materials in space provided or designated by the Contractor against damage, stains, scratches, corrosion, weather, construction debris and environmental conditions.
2. Deliver materials to the site in the manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name and manufacturer's name.
3. Store materials under cover in a dry and clean location, off the ground. Remove delivered materials that are damaged or not suitable for installation from the job site and replace with acceptable materials.

C. Hoisting: All required hoisting and movement of equipment is the responsibility of the Elevator Contractor.

1.8 COORDINATION

A. General: Coordinate the following requirements with the other trades.

B. Cast-in-Place Concrete:
1. Provide other hoistway and pit requirements, including location of sump pits.

C. Structural Steel: Including, but not limited to, elevator control rooms, hoistways and pits, sill supports, rail supports.

D. Miscellaneous Steel: Pit ladders, working platforms, inspection platforms, guard rails, divider beams.

E. Electric: Electrical service, mainline disconnects, 110 VAC disconnects, outlets, lights, switches in elevator control rooms and pits. Fire alarm devices and wiring, security devices and wiring.

F. Sprinklers: Including installation of sprinkler systems in the elevator pits or shaft as per NFPA 13.

G. HVAC: Provide necessary information to General Contractor and coordinate installation of equipment for elevator control rooms.

H. Finishes: Cab interiors, hoistway entrances, fixtures, smoke guard curtains.

I. Elevator Cab Flooring:
   1. Material and finish as specified.
   2. Flooring installation must be coordinated to ensure car sill is installed level with finished floor.

J. Security Equipment: Coordinate locations in elevator control rooms and cabs where cables, conduit, and other components for CCTV and/or security equipment must be installed.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair, restore, or replace elevator equipment that fails due to defective materials or poor workmanship within specified warranty period.

B. Warranty Period: Twenty-Four (24) months from date of Substantial Completion:
   1. The Elevator Contractor guarantees that the materials and workmanship of the apparatus installed by them and any subcontractor, under this contract, is first class in every respect and that they will make good on any defects not due to ordinary wear and tear or improper use, which may develop within one year from the date of final acceptance of all equipment.
   2. Manufacturer's warranty to repair or replace defective products or their components in the event of defects within a specified period.
   3. Neither the final payment nor any provisions of the contract documents relieve the Elevator Contractor of any obligation provided by law. They shall remedy any defects and pay all expenses for any damage to other work.
   4. The warranty as outlined above, for all devices, starts from the date of Substantial Completion, by the Consultant and the Owner, of all work specified and intended under these contract documents.

1.10 MAINTENANCE

A. General:
   1. All maintenance is performed according to the guidelines stated in manufacturer's Maintenance and Operations manuals.
   2. Maintenance records for each device, including lubrication logs, check charts, are provided in each control room.

B. Construction Maintenance:
   1. Upon substantial completion of a device, after receiving sign-off from the governing authorities and acceptance from Consultant and/or Contractor, the device may be accepted for service before completion of the entire project.
   2. During the Construction Maintenance period, the necessary preventive maintenance is performed on a scheduled basis.
   3. Provide the necessary protection of the hoistway entrances and sills, hoistway fixtures, cab interiors and fixtures and car door sills.
   4. Replacement or repair of components, due to misuse by others, is the responsibility of the Contractor/Owner.
   5. Include emergency callback service six-days/week, 6 AM – 6 PM PST with response time of sixty minutes or less.

C. Warranty Maintenance:
   1. Upon final acceptance of each device, subsequent to receiving acceptance and sign-off from the governing authorities and final acceptance, each device is accepted for full operation.
   2. The warranty maintenance period begins for each device when all conditions in the above paragraph are met and will continue for a specified period.
   3. The warranty maintenance program includes the following:
      a. Monthly examinations, including adjustments, cleaning, and lubrication of equipment.
      b. 24-hour Emergency Call back service is provided at no additional cost to Owner.
      c. Replacement of components as required, using only components produced by the original manufacturer.
      d. Each control room is equipped with a lockable storage cabinet to contain the necessary spare parts.

D. Maintenance Specification:
   1. Upon completion of the Warranty Maintenance period, the Elevator Contractor will provide the personnel to service the vertical transportation equipment.
   2. Full-Service Maintenance Specification commences upon the completion of the warranty maintenance period for a term of two (2) years: If specifications for a comprehensive service agreement have not been provided, then the Contractor provides a proposal for a full-service agreement which covers the following:
      a. All required inspections and tests.
      b. 24-hour emergency call service at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 REFERENCES

A. Definitions: Terms used are defined in the latest edition of the Safety Code for Elevators and Escalators, ASME A17.1.

B. American Society of Mechanical Engineers:
   1. ASME A17.1, Safety Code for Elevators and Escalators.
   2. ASME A17.2, Guide for Inspection of Elevators, Escalators, and Moving Walks.

3. ASME A17.5, Elevator and Escalator Electrical Equipment.
4. ASME A17.6, Standard for Elevator Suspension, Compensation, and Governor Systems.

C. International Building Code (IBC)

D. National Fire Protection Association (NFPA):
1. NFPA 13, Installation of Sprinkler Systems.
2. NFPA 70, National Electric Code.
3. NFPA 80, Fire Doors and Windows.
4. NFPA 101, Life Safety Code.

E. Accessibility:
1. American National Standard Institute (ANSI): A117.1, Accessible and Usable Buildings and Facilities.

2.2 MANUFACTURERS

A. Subject to compliance with project requirements, provide products by one of the following:
1. MRL Systems:
   a. KONE Incorporated: MonoSpace 700.
   b. Mitsubishi Electric Corporation: Diamond-Trac.
   c. Otis Elevator Company: G2S, Gen2 Underslung Series G2O, Gen2 Overslung Series.
   d. Schindler Elevator Corporation: 5500.
   e. TK Elevator Corporation: EVO 200, Synergy Self Supported, Building Supported.
   f. Manufacturer’s standard components, including machines, controllers, door equipment, fixtures, and cab enclosures, are approved.
2. Hoistway Entrance:
   a. Car 1: 5WL or Checker Plate, Stainless Steel, Removable.
3. Two-Way Communication Device:
   a. RingComm.
   b. EMS.
   c. TOA.

2.3 FIELD CONDITIONS

A. Seismic:
1. Elevator system withstands the effects of earthquake motions determined according to SEI/ASCE 7 and California Building Code and complies with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
2. The term “withstand” means the system will remain in place without separation of any parts when subjected to the seismic forces specified.
3. Provide earthquake equipment required by ASME A17.1/CSA B44.
4. Provide Alpha-Numeric display if Earthquake Mode is needed.
5. Provide seismic switch required by SEI/ASCE 7.
6. Design earthquake spectral response acceleration short period (Sds):1.443.

7. Occupancy Category: III.
8. Project Seismic Design Category: E.
9. Elevator Component Importance Factor (Ip): 1.5.

2.4 PERFORMANCE REQUIREMENTS

A. Car Speed: ±3% of contract speed under any loading condition.

B. Car Capacity: Safely lower, stop, and hold 125% of rated load.

C. Car Stopping Zone: ±1/4" under any loading condition.

D. Door Times: Seconds from start to fully open or fully closed:
   1. Door Open: 2.7 seconds.
   2. Door Close: 3.7 seconds.

E. Car Floor-to-Floor Performance Time: 11.0 seconds from start of doors closing until doors are 3/4 open, and car is level and stopped at next successive floor under any loading condition or travel direction; floor height 14'-0", between floors 2 and 3.

F. Car Ride Quality:
   1. Acceleration and Deceleration: Smooth, constant, and not less than 2.5 feet/second² with an initial ramp between 0.5 and 0.75 second.
   2. Sustained Jerk: Not more than 6 feet/second³ or twice the rate of acceleration.
   3. Horizontal and vertical acceleration within car during all riding and door operating conditions: Not more than 15 mg peak-to-peak (adjacent peaks).
   4. Measurement Standards: Measure and evaluate ride quality consistent with ISO 18738, using low pass cutoff frequency of 10 Hz and A95 peak-to-peak average calculations.

G. Noise and Vibration Control:
   1. Airborne Noise:
      a. Measured noise level of elevator equipment and its operation does not exceed 55 dBA inside car under any condition including door operation and car ventilation exhaust blower on its highest speed.
      b. Limit noise level in the control room and control space relating to elevator equipment and its operation to no more than 55 dBA.
      c. All dBA readings to be taken 3'-0" off the floor and 3'-0" from the equipment using the “A” weighted scale.
   2. Vibration Control: All elevator equipment is mechanically isolated from the building structure and other components to minimize noise and vibrations being transmitted to occupied areas of the building.

2.5 ELEVATORS

A. Two Passenger Elevators, Cars 1 and 2:
   1. Capacity: 4,000 lbs.
   2. Class of Loading: Class C3.
   3. Contract Speed: 350 fpm.

4. Roping: Manufacturers Standard
5. Machine: Gearless.
6. Machine Location: Overhead in Hoistway.
7. Control System, Supervisory Control, Microprocessor-Based: Duplex selective collective.
8. Openings:
   a. Elevator 1: 6 front, 6 rear.
   b. Elevator 2: 6, all front.
9. Floors Served.
   a. Elevator 1: Front: 1-6; Rear: 1R – 6R.
   b. Elevator 2: 1-6, all front
10. Minimum Clear Height to Underside of Canopy: 9'-0" high.
11. Entrance Size: 4'-0" wide x 8'-0" high.
12. Entrance Type: Single-speed center-opening.

2.6 MATERIALS

A. Steel:
   1. Sheet Steel (Furniture Steel for Exposed Work): Stretcher-leveled, cold-rolled, commercial quality carbon steel, complying with ASTM A366, matte finish.
   2. Sheet Steel (for Unexposed Work): Hot-rolled, commercial quality carbon steel, pickled and oiled, complying with ASTM A568/A568M-03.
   3. Structural Steel Shapes and Plates: ASTM A36.

B. Stainless Steel:
   1. Type 302 or 304 400 series complying with ASTM A240, with standard tempers and hardness required for fabrication, strength, and durability.
   2. Apply mechanical finish on fabricated work in the locations shown or specified, Federal Standard and NAAMM nomenclature, with texture and reflectivity required to match Architect's sample. Protect with adhesive paper covering.
      a. No. 4 Satin:
         1) Directional polish finish.
         2) Graining directions as shown or, if not shown, in longest dimension.
      b. Textured:
         1) .050" mean pattern depth with bright directional polish (No. 4 satin finish).
         2) 5WL as manufactured by Rigidized Metals.
   3. Extruded Stainless Steel:
      a. 304 stainless steel per ASTM A276.
      b. Hot finished and stretched straightened.
      c. Polished finish.

C. Aluminum:
   1. Extrusions per ASTM B221; sheet and plate per ASTM B209.
   2. Die Cast Aluminum, ASTM B108, Alloy 356.0, T6.
   3. Extruded Aluminum, FS QQ-A 200/8, Alloy 6061, T6.

D. Nickel-Silver: Extruded nickel-silver:
   1. C77600 nickel-silver

2. Hot extruded, temper code M30

E. Plastic Laminate:
1. ASTM E84 Class A and NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050" ±.005" thick.
2. Exposed Surfaces: Color and texture selected by Architect.
3. Concealed Surfaces: Manufacturer's standard color and finish.

F. Paint Finishes:
1. General:
   a. Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer.
   b. Galvanized metal need not be painted.
2. Prime Finish:
   a. Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces.
   b. Sand smooth and apply final coat of primer.
3. All equipment and metal work installed under this contract, which does not have a baked enamel or special architectural finish, and which is exposed in the hoistway, is cleaned, and painted one field coat of enamel.
4. All control room equipment is painted upon completion of the installation with the manufacturer's standard machinery enamel.
5. Elevator designation (number and/or letter) is prominently indicated on all control room and machinery space equipment, top of car crosshead and pit equipment.

2.7 ALTERNATES

A. Five (5) year Full-Service Maintenance Agreement. Commencing upon completion of the warranty maintenance period.

B. Car 1: Provide Door Guard or equivalent jamb protection material at all entrances.

2.8 OPERATION

A. General:
1. Cars automatically slow down and stop level at floors in response to car and landing calls with stops made in sequence in the established direction of travel, regardless of order in which buttons are pressed.
2. Landing calls are canceled when the assigned car arrives at the landing.
3. Automatic Dispatch Failure: Provide auxiliary dispatch system to automatically dispatch elevators in the event of failure of the primary control system.
4. Hall Call Button Failure: Should failure of hall call button system occur, initiate operation providing predetermined service to all landings; elevators respond normally to car calls.
5. Automatic Leveling:
   a. When arriving at a floor cars level to within 1/8" above or below the landing sill prior to opening doors, without travelling past the landing during leveling

b. Maintain leveling accuracy regardless of carload, direction of travel, rope slippage or stretch.

6. Power Conservation:
   a. Shut off car interior illumination and ventilation after adjustable period, no less than 15 minutes, of no elevator demand.
      1) Lighting and ventilation shall remain on during entrapment.
   b. turn on prior to opening car doors when elevator demand returns.

B. Door Operation:
   1. Automatically open doors when car arrives at a floor.
   2. Stop and reopen doors or hold doors in open position upon activation of “door open” button.
   3. At expiration of normal dwell time, or upon activation of “door close” button, close doors:
      a. Prevent doors from closing and reverse doors at normal opening speed if door reopening device beams are obstructed while doors are closing, except during nudging operation.
      b. In event of door reopening device failure, provide for automatic shutdown of car at floor level with doors open.
      c. Close cycle does not begin upon activation of “door close” button until normal door dwell time for a car or hall call has expired, except firefighters’ operation.
   4. Nudging Operation:
      a. After beams of door reopening device are obstructed for a predetermined time interval (minimum 20.0-25.0 seconds), sound warning signal, and attempt to close doors with maximum of 2.5 foot-pounds kinetic energy.
      b. Activation of the door open button overrides nudging operation and reopens doors.
   5. Interrupted Beam Time:
      a. When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds.
      b. When beams are interrupted after the initial 3.0 second hold open time, reduce time doors remain open to an adjustable time of approximately 1.0-1.5 seconds after beams are reestablished.
   6. Differential Door Time:
      a. Field adjustable time that doors remain open after stopping in response to calls.
      b. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
      c. Hall Call:
         1) Hold open time adjustable between 5.0 and 8.0 seconds.
         2) Use hall call time when car responds to coincidental calls.
      d. Elevator 1: Provide front or rear selective door operation.

C. Independent Service:
   1. When feature is activated from within the car, allow control of car from buttons and controls inside the car.
   2. Close doors by constant pressure on desired destination floor button or door close button.
   3. Open doors automatically upon arrival at selected floor.

D. Load Weighing:
   1. Provide cars with adjustable load weighing device which monitors cable tension.
   2. Control system to provide dispatching at main floor in advance of normal intervals when car fills to a field adjustable, 10%-100%, percentage of rated capacity.
   3. Provide hall call by-pass when car is filled to a field adjustable, 10%-100%, percentage of rated capacity.
   4. Audible overload signaling device inside elevator cab shall be activated upon load weighing device sensing carload has reached or exceeded a pre-determined percentage of capacity.
   5. Doors will no close when overload signaling device is active.

E. Duplex Selective Collective Operation, Elevators 1 and 2:
   1. Elevators operate via momentary pressure buttons to:
      a. place hall call by selecting direction of travel at each hall landing (up and down buttons at each intermediate landing, single buttons at each terminal landing).
      b. place car call by selecting destination floor from inside the car (individual buttons for each floor served).
   2. Hall calls, other than calls placed at the landing at which car is standing, start car and cause the car to stop at first landing for which a call is registered in the direction of travel.
   3. Car calls cause the car to stop at the floors registered in the order the car arrives at each selected floor in its current direction of travel.
   4. Free Car:
      a. When there are no calls in the system, one car is automatically dispatched to the elevator discharge level (home car), park other car (free car) at its last stop above elevator discharge level.
      b. An idle free car answers call above or below it, except calls at main or Basement landings (where applicable).
      c. When free car travels to main landing in response to a car call, it becomes home car and former home car travels to a middle floor above main landing and becomes the free car.
      d. When free car is responding to calls, home car shall respond to the following:
         1) Up calls below UP traveling free car.
         2) All Up and Down calls behind DOWN traveling free car.
         3) Any hall calls registered when free car is delayed in its normal operation for a predetermined period.
      e. When both cars are responding to registered car and hall calls, the first car to complete its calls becomes the assigned home car and is dispatched automatically to the Main Landing.
      f. Only one car responds to each hall call.
   5. If either car is removed from service, the other car responds to all registered hall calls and its own car calls.
   6. Car and Hall Lanterns:
      a. Lanterns provide audio and visual signal upon each stop, regardless of responding to car or hall call.

b. Visual signal remains active from commencement of door opening until doors are completely closed.

F. Standby or Emergency Power Operation:
1. The terms Standby Power and Emergency Power are both referred to as Emergency Power in this Section. Elevator operation is the same when either is provided.
2. Where emergency power is provided to the elevator main disconnects and required by the Building Code the elevator installation shall comply with the Emergency Power Operation requirements of ASME A17.1 as modified by any superseding Building Code requirements.
3. Where emergency power is not provided, all elevator controller software and sequencing capabilities to allow future emergency power operation shall be included in the elevator control systems based on the applicable code requirements for new buildings in effect at the time of project permit application.
4. Operation is activated by a signal from an Automatic Transfer Switch (ATS) to elevator controls indicating the Emergency power source is operational.
   a. Start and run one car in each group at contract car speed and capacity.
   b. Illuminate “ELEVATOR EMERGENCY POWER” signals.
5. Automatic Selection and Return to Designated Landing: Provide automatic selection and return to designated landing for all elevator banks and single elevators in the building.
6. Intergroup and single car Emergency Power Operation:
   a. Elevator systems shall be designed to sequentially recall one elevator at a time in one bank and/or each single elevator at time. When all elevators in the first bank are recalled and parked, that control system shall communicate with the elevator control system for the next bank of elevators to commence automatic selection and return to designated landing operation until all elevators in the building are at their designated return landings with the doors open.
   b. Once all elevators have completed the return sequence one or more individual elevators shall be returned to service
7. Restoration of Normal Power:
   a. At least 20 seconds prior to transfer from emergency power to normal power at the ATS, a pre-transfer signal is supplied to the elevator control system from the ATS.
   b. Elevators operating on emergency power stop at the next available landing and remain there until normal power is restored.

G. Firefighters’ Emergency Operation: Provide equipment and operation in accordance with code requirements.

H. Motion Control:
1. Microprocessor-based AC variable-voltage, variable frequency with digitally encoded closed-loop velocity feedback suitable for operation specified and capable of providing smooth, comfortable car acceleration, retardation, and dynamic braking.
2. Limit the difference in car speed between full load and no load to not more than ±3% of the contract speed.

I. Emergency Lighting, Communication, and Alarm:
   1. Car mounted battery unit with solid-state charger to operate alarm bell, car emergency lighting, and communication system.
   2. Car lighting and communication shall be provided with a minimum of 4 hours of operation on back-up power during a loss of normal power, and a minimum of 1 hour of operation for car-mounted alarm and any remote alarm mounted at the designated level.
   3. Battery to be rechargeable with minimum five-year life expectancy.
   4. Provide constant pressure light test button in service compartment of car operating panel.
   5. Provide lighting integral with normal car lighting system.

J. Emergency Battery Operation:
   1. Upon loss of normal power automatically move the car to the nearest landing depending on the load in the car.
   2. Upon arrival at the landing, the elevator doors open automatically, and the elevator is removed from service.
   3. Upon restoration of normal power, the elevator shall automatically resume normal operation.
   4. The auxiliary power source is provided via 12-volt D.C. battery units installed in equipment space.
   5. Include solid-state charger and testing means mounted in a common metal container.
   6. Battery to be rechargeable lead acid or nickel cadmium with a five-year life expectancy.

K. Card/Proximity Reader Security System:
   1. Provide provisions inside all cars for reader unit.
   2. Mount reader unit as directed by Architect. Connect to card reader via traveling cable to terminal interface and relays in equipment space.
   3. Provide filler plate to match card slot size or proximity reader size and car return panel finish, including direction of graining. Provide filler plate to accommodate future security device installation.
   4. Provide output signal to facilitate system tracking of floor access.

2.9 EQUIPMENT SPACE EQUIPMENT

A. Arrange equipment in spaces shown on drawings.

B. Solid State Power Conversion and Regulation Unit:
   1. Provide solid-state, alternating current, variable voltage, variable frequency (ACV³F), IGBT converter/inverter regenerative drive.
   2. Design unit to limit current, suppress noise, and prevent transient voltage spikes into building power supply.
      a. Provide internal heat sink cooling fans for the power drive portion of the converter panels.
   3. Conform to IEEE standard 519-2014 for line harmonics and switching noise.
   4. Provide isolation transformers, filter networks, and choke inductors.

5. Suppress solid-state converter noises, radio frequency interference, and eliminate regenerative transients induced into the mainline feeders or the building standby power generator.
6. Supplemental direct-current power for the operation of hoist machine brake, door operator, dispatch processor, signal fixtures, from separate static power supply.
7. ACV³F Drives are regenerative and utilize IGBT converter/inverter and dynamic braking during overhauling condition.

C. Resistor Load Bank:
   1. Provide means of diverting regenerated power during emergency power operation and restoring regenerated power delivery back to the electrical distribution system following emergency power operation termination.
   2. Provide resistor load bank to discharge regenerative power during emergency power operation.
   3. Load bank is installed on the load side of the mainline disconnect.

D. Encoder: Direct drive, solid-state, digital type. Update car position at each floor and automatically restore after power loss.

E. Controller:
   1. UL/CSA labeled.
   2. Compartment:
      a. Securely mount all assemblies, power supplies, chassis switches, relays, on a substantial, self-supporting steel frame.
      b. Completely enclose equipment with covers.
      c. Provide means to prevent overheating.
   3. Relay Design:
      a. Magnet operated with contacts of design and material to insure maximum conductivity, long life, and reliable operation without overheating or excessive wear.
      b. Provide wiping action and means to prevent sticking due to fusion.
      c. Contacts carrying high inductive currents are provided with arc deflectors or suppressors.
   4. Microprocessor Hardware:
      a. Provide built-in noise suppression devices that provide a high level of noise immunity on all solid-state hardware and devices.
      b. Provide power supplies with noise suppression devices.
      c. Isolate inputs from external devices (such as pushbuttons) with opto-isolation modules.
      d. Design control circuits with one leg of power supply grounded.
      e. Safety circuits are not affected by accidental grounding of any part of the system.
      f. System automatically restarts when power is restored.
      g. System memory is retained in the event of power failure or disturbance.
      h. Equipment is provided with Electro Magnetic Interference (EMI) shielding within FCC guidelines.
   5. Wiring:
      a. CSA labeled copper for factory wiring.

b. Neatly route all wiring interconnections and securely attach wiring connections to studs or terminals.
c. Provide labels for all extra or spare wires, neatly organized at base of controller cabinet.

6. Data Monitoring:
   a. Provide an onboard monitor or screen, either inside the controller or in a stand-alone PC station, to display an easily understood format.
   b. Upon command, the current operating parameters, individual car status, floor positions or other selected operational features will be displayed.
   c. Display a minimum of 20 previous errors, which will be logged for statistical evaluation.
   d. Provide means for hard copy printouts.
   e. Diagnostic display will support monitoring of elevator motion, velocity, door operation parameters and timing functions.
   f. Non-volatile memory is required to store group operation data with provisions for data logging and hard copy reporting.
   g. Network connectivity provision is incorporated in the basic dispatching control system.
      1) This provision may be employed for traffic analysis, hard copy computation and/or remote monitoring of status conditions utilizing an isolated PC and compatible printer for reports or graphs.
      2) All reports are time and date stamped to confirm reporting period.
   h. Monitor employs color video displays for the following information:
      1) Display screen (group operations statistics).
      2) Monitoring screen (diagnostics, system status).
      3) Performance screen (traffic analysis).
   i. Features required regarding remote and additional location monitoring, as indicated in other applicable sections, apply.
7. Permanently mark components with symbols shown on wiring diagrams.
8. Provide control panel compliant with UL 508A SB.SCCR of 5000A required.

F. Electrical Wiring and Wiring Connections:
1. Conductors and Connections: Copper throughout with individual wires coded and connections on identified studs or terminal blocks.
2. The use of splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes is prohibited.
3. Conduit:
   a. Galvanized steel conduit, EMT, or duct.
   b. Flexible conduit length not to exceed 3'-0".
4. Traveling Cables:
   a. Tag spares in equipment space.
   b. Provide cables from controller to car top.
5. Auxiliary Disconnect: Provide controller or machine mounted auxiliary, lockable “open” disconnect.
6. Auxiliary Wiring:
   a. Provide dedicated equipment space junction boxes for the following:
      1) Fire alarm initiating devices.
      2) Emergency two-way communication system.
      3) Network connectivity.

4) Paging speaker.
5) CCTV.
6) Digital video display.
7) Security system and card reader interface terminals and relays.
8) Intercom, announcement speaker, and/or background music.

b. Provide conduit, wiring and connections from controller space junction box to each controller in the equipment space for the following:
1) Fire alarm initiating devices.
2) Emergency two-way communication system.
3) Network connectivity.
4) Paging speaker.
5) CCTV.
6) Digital video display.
7) Security system and card reader interface terminals and relays.
8) Intercom, announcement speaker, and/or background music.

2.10 HOISTWAY EQUIPMENT

A. Gearless Traction Hoist Machine:
1. AC induction or P.M.S.M. ACV³F gearless traction motor with brakes, drive sheave, and deflector sheave mounted in proper alignment.
2. Provide hoist machine mounted direct drive, digital, closed-loop velocity encoder.
3. Provide machine with an electromechanical brake.
a. The brake is spring applied and electrically released.
b. Brake shoes are applied to the braking surface simultaneously and with equal pressure.
4. Provide means to prevent ascending car over-speed and unintended car movement via dual modular redundant braking system.
5. Provide ladders and platforms with handrails and toe boards for overhead sheave and governor access within the bounds of the equipment space.

B. Machine and Equipment Support Beams:
1. Provide structural steel beams required for direct support of and attachment to building structure of hoist machine, deflector sheaves, overhead sheaves, governor, and hoist rope dead-end hitch assemblies.
2. Provide bearing plates, anchors, shelf angles, blocking, embedment, for support and fastening of machine beams or equipment to the building structure.
3. Isolate machine and overhead sheave beams to prevent noise and vibration transmission to building structure.

C. Governor:
1. Centrifugal-type, car-driven pit-mounted with pull-through jaws and bi-directional shutdown switches.
2. Provide required bracketing and supports for attachment to building structure.
3. Provide manual remote reset capability at controller.

D. Guide Rails:

1. Planed steel T-sections for car and counterweight of suitable size and weight for the application, including seismic reactions, including brackets for attachment to building structure.
2. No additional structural points of attachment other than those shown on the Contract Documents will be provided.
3. Provide rail backing and intermediate counterweight tie brackets.

E. Sheaves:
1. Machined grooves and sealed bearings.
2. Provide mounting to machine beams, car, and counterweight structural members, or building structure.

F. Counterweight: Steel frame with metal filler weights.

G. Counterweight Guides: Spring dampened roller guides.

H. Counterweight Runway Guard: Where counterweight is located between adjacent elevators, provide counterweight guard along entire runway next to the adjacent elevator.

I. Seismic Equipment:
1. Provide design, components, and operation per governing code.
2. Dual counterweight derailment sensing wires located vertically on each side of counterweight the entire height of travel.
3. Counterweight frame equipped with a minimum of four derailment rings.
4. Provide dual axis seismic switch that activates at no less than 0.15 times gravity in the vertical or horizontal directions. A minimum of one seismic switch shall be provided per car or group of elevators.
5. Counterweight retainer plates must be bolted.

J. Governor Rope and Encoder Tape Tensioning Sheaves:
1. Mount sheaves and support frame on pit floor or guide rail.
2. Provide frame with guides or pivot point to enable free vertical movement and proper tension of rope and tape.

K. Suspension Means:
1. 8 x 19 or 8 x 25 Seale construction, traction steel.
2. Fasten with staggered length, adjustable, spring isolated wedge shackles.
3. Noncircular elastomeric-coated steel belt comprising of several steel cords arranged in parallel and molded within a coating.
4. Approved governor rope.

L. Terminal Stopping: Provide normal and final devices.

M. Electrical Wiring and Wiring Connections:
1. Conductors and Connections:
    a. Copper throughout with individual wires coded and connections on identified studs or terminal blocks.

b. The use of splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes is prohibited.
c. Provide 20% spare conductors for each wire type.
d. Run spare wires from car connection points to individual elevator controllers in the equipment space.

2. Conduit:
   a. Galvanized steel conduit, EMT, or duct.
   b. Flexible conduit between isolated equipment, length not to exceed 3'-0".
   c. Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protective devices.
   d. Coordinate conduit from the closest hoistway of each elevator or group or single elevator to the firefighters' control panel. Provide wiring.
3. Traveling Cables:
   a. Flame and moisture-resistant outer cover.
   b. Prevent traveling cable from rubbing or chafing against hoistway or equipment within hoistway.
   c. Provide the following minimum composition, which are not considered spares:
      1) Five pair of shielded 20-gauge wire for card reader.
      2) Two pair of shielded 18-gauge wire for CCTV, from car controller to car top junction box, plus 3'-0" excess loop at both ends.
      3) Two pair of 18-gauge wire for CCTV power.
      4) Two pair of 18-gauge wire for emergency communication system power.
   d. Provide eight pair of spare shielded communication wires in addition to those required to connect specified items.
   e. Tag spares in control room. Provide cables from controller to car top.
   f. Support traveling cable by suspending from supports by means that automatically tighten around the cable when tension is increased.
4. Auxiliary Wiring: Provide conduit, wiring and connections for systems specified.

N. Entrance Equipment:
1. Two-point hanger roller with non-metallic roller surface and suspension with eccentric upthrust roller adjustment.
2. Bar or formed, cold-drawn removable steel door tracks with smooth roller contact surface.
3. Door Interlocks: Operable door locks without retiring cam.
4. Door Closers:
   a. Spring, spirator, weighted, or jamb/strut mounted.
   b. Design and adjust to ensure a smooth and quiet mechanical close of doors.

O. Floor Numbers: Stencil paint 4" high floor designations in contrasting color on inside face of hoistway doors and hoistway fascia. Must be visible from within car.

2.11 HOISTWAY ENTRANCES

A. Entrance Assemblies:
1. Complete entrances bearing fire labels from a certified testing laboratory approved by authority having jurisdiction.

2. Provide entrance assemblies bearing 1½-hour label.
3. Paint all exposed ferrous metal black.

B. Frames:
1. Bolted and lapped head to jamb assembly at all floors.
2. Clad frames with finish material indicated in finish schedule, at all floors.
3. Provide Arabic floor designation/tactile marking plates:
   a. Centered at 60" above finished floor.
   b. Located on both side jambs of all entrances.
   c. Minimum 4" in height.
   d. Tactile indications below Arabic floor designation.
   e. Permanently fastened.
4. Provide car identification label:
   a. Mounted directly below floor designation/Tactile marking plates.
   b. Finish and design to match floor designation/Tactile marking plates.
   c. Permanently fastened.
5. Provide plates at main egress landing with “Star” designation.
6. For designated emergency car, provide “Star of Life” cast designation plates at height of 78"-84" above finished floor on both side jambs at all floors.

C. Door Panels:
1. Sandwich construction without binder angles.
2. Provide one leading edge of doors with rubber astragals.
3. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel.
4. Provide one separate 4” steel reinforcement safety gib mounted between door gibs, where not integrated with door gibs.

D. Sight Guards:
1. Same material, finish, and height as hoistway entrance door panels.
2. Construct without sharp edges.

E. Sills: Extruded nickel silver.

F. Sill Supports:
1. Structural or formed steel designed to support sill load.
2. Design to eliminate need for grout under the sill.

G. Fascia, Platform Guards and Hanger Covers:
1. 16-gauge furniture steel with Contractor’s standard finish.
2. Provide full height fascia, platform guards, and hanger covers where rear entrances are not provided.

H. Struts and Headers:
1. Provide support of all entrances to building structure including connections to building structure.
2. Provide door open bumpers on entrances equipped with vertical struts.

I. Finish of Frames and Doors:

1. Reinforced textured finish stainless steel.
2. Provide final painting requirements to General Contractor where factory prime finish is specified.

J. Hoistway Access:
   1. Hoistway Access Switches:
      a. Mount in entrance frame side jamb at top floor.
      b. Provide switch without faceplate.

2.12 PIT EQUIPMENT

A. Buffers:
   1. Provide Oil type with blocking and support channels.
   2. Stencil car number on buffer.

B. Pit Access:
   1. Hoistway Access Key Switch:
      a. Provide key switch at lowest terminal landing.
      b. Mount in entrance frame side jamb.
      c. Provide switch without faceplate.
   2. Provide pit stop switches.
   3. Provide pit access door switch configured to disable elevators.

C. Counterweight Guard: Metal guard in pit in front of counterweight where no compensation is provided or where there is no space greater than 20" between the compensation means, suspension means, counterweight rails, or guards. Provide metal screen between elevators 6’-0” from pit floor.

2.13 CAR EQUIPMENT

A. Frame: Welded or bolted formed steel channel construction to meet load classification specified.

B. Safety Device: Type “B,” flexible guide clamp.

C. Platform:
   1. Design and construct to accommodate load classification requirements.
      a. Provide Class “C3” construction.
   2. The car platform consists of a steel frame with necessary steel stringers, all securely welded together.
   3. Isolate the passenger elevator platform.
      a. The support frame includes rubber pads on which the platform rests.
      b. No mechanical connections between platform and frame.
   4. Work Light Fixtures and AC Receptacles: Provide permanent mounted work light fixtures below platform, complete with proper lamp guards.

D. Platform Guard: Minimum 48" high, reinforced and braced to car platform front, and rear at Car 1, Floor 1, with Manufacturer’s standard finish

E. Cartop Guard Rail: Provide a railing system provided on the outside perimeter of the car top on all sides where the horizontal distance between the edges of the car top and the adjacent hoistway enclosure exceeds 12".

F. Car Guides: Roller type with three or more spring dampened, sound-deadening rollers per shoe. Minimum 3¼" outside diameter.

G. Cab Steadying Plates:
   1. Provide and install top of car steadying plates.
   2. Emphasis is placed on proper tension to car styles allowing minimal lateral movement of the cab.
   3. Steadying plates are isolated using non-metallic guides or rollers.

H. Sills:
   1. One-piece extrusion with extension between car entrance columns to face of car front return.
   2. Extruded extension to match finish of sill.
   3. Nickel silver.

I. Door Panels:
   1. Sandwich construction without binder angles.
   2. Provide one leading edges of doors with rubber astragals.
   3. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel.
   4. Construct door panels with interlocking, stiffening ribs.

J. Door Hangers: Two-point suspension hanger roller with non-metallic surface and eccentric roller adjustment.

K. Door Track: Bar or formed, cold-drawn removable steel track with smooth roller contact surface.

L. Door Header: Construct of minimum 12-gauge steel, shape to provide stiffening flanges.

M. Door Electrical Contact: Prohibit car operation unless car door is closed. Provide car door interlock to prevent opening of car doors outside the unlocking zone, where clearance between the car platform and hoistway enclosure exceeds code maximum on the loading side.

N. Door Clutch:
   1. Heavy-duty clutch, linkage arms, vane assembly and pickup rollers or cams to provide positive, smooth, quiet door operation.
   2. Design clutch so car doors can be closed while hoistway doors remain open.

O. Restricted Opening Device:
   1. Provide mechanical car door restrictor to prevent opening of doors when outside unlocking zone.
   2. Plunger type restrictors are not applicable.
   3. Utilize mechanical angle to prevent door opening

P. Door Operator:
   1. High-speed heavy-duty door operator capable of opening doors at no less than 2.5 fps.
   2. Accomplish reversal within 2½" of door movement.
   3. Provide solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position, and motor current.
   4. Provide a minimum of four controller-based motion profiles, per floor, per door, to maintain consistent, smooth, and quiet door operation at all floors, regardless of door weight or varying air pressure.

Q. Door Reversing Device:
   1. Infrared Reopening Device:
      a. Black fully enclosed device with full screen infrared matrix or multiple beams extending vertically along leading edge of each door panel to minimum height of 74" above finished floor.
      b. Provide additional beams full height of door panels.
      c. Reverse doors at normal opening speed if beams are obstructed while doors are closing, except during nudging operation.
      d. In event of device failure, provide for automatic shutdown of car at floor level with doors open.
   2. Nudging Operation:
      a. After door close is obstructed for a predetermined time interval (minimum 20.0-25.0 seconds), warning signal sounds, and doors close with a maximum of 2.5 foot-pounds kinetic energy.
      b. Door open button overrides nudging operation and reopen doors.
   3. Interrupted Beam Time:
      a. When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds.
      b. When beams are interrupted after the initial 3.0 second hold open time, reduce remaining adjustable open time to 1.0-1.5 seconds after beams are reestablished.
   4. Differential Door Time:
      a. Provide separate adjustable timers to vary door dwell time after stopping in response to calls.
      b. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
      c. Hall Call:
         1) Hold open time adjustable between 5.0 and 8.0 seconds.
         2) Use hall call time when car responds to coincidental calls.

R. Car Operating Panel:
   1. Passenger:
      a. Two car operating panels without faceplates:
         1) Consisting of a metal box containing the vandal resistant operating fixtures, mounted behind the car swing front and rear return panels.
      b. Suitably identify floor buttons, alarm button, door open button, door close button and emergency push-to-call button with cast tactile symbols recessed flush rear-mounted.
      c. Pushbuttons:

1) Provide minimum 3/4" diameter raised or flush floor pushbuttons which illuminate to indicate call registration.

d. Locate operating controls no higher than 48" above the car floor; no lower than 35" for emergency push-to-call button and alarm button.

e. Locked Firefighters Operation Panel:
   1) For fire officer use and independent service only.
   2) Openable by the same key which operates the Fire Operation switch.
   3) Panel is provided with solenoid operated key switch which automatically opens in the event of Firefighters' Phase I activation.
   4) Including the following features:
      a) Phase II fire access switch.
      b) Firefighters' visual indication.
      c) Call cancel button.
      d) Stop switch, manually operated.
      e) Door open button.
      f) Door close button.
      g) Floors served.

f. Provide "door open" button to stop and reopen doors or hold doors in open position.

g. Provide "door close" button to activate door close cycle. Cycle does not begin until normal door dwell time for a car or hall call has expired, except firefighters' operation.

2. Service Compartment:
   a. Provide lockable service compartment with recessed flush door.
   b. Door material and finish matches car return panel or car operating panel faceplate.
   c. Inside surface of door contains an integral flush window for displaying the elevator operating permit.
   d. Include the following controls in lockable service cabinet with function and operating positions identified by permanent signage or engraved legend:
      1) Access switch.
      2) Light switch.
      3) Four-position exhaust blower switch.
      4) Independent service switch.
      5) Constant pressure test button for battery pack emergency lighting.
      6) 120-volt, AC, GFCI protected electrical convenience duplex outlet.
      7) Card reader override switch.
      8) Keyed stop switch.

3. Provide black filled, engraved, or approved etched signage as follows with approved size and font:
   a. Phase II firefighters' operating instructions on inside face of firefighters' compartment door.
   b. Red filled engraved firefighters' operation on outside face of compartment door.
   c. Building identification car number over main and auxiliary car operating panel.
   d. Car capacity in pounds on main car operating panel service compartment door.
   e. Loading classification and description on car operating panel

f. “No Smoking” over main car operating panel.

S. Car Top Control Station:
1. Mount to provide safe access and utilization while standing on car top.
2. Operating device contains Up and Down direction buttons, a Run button, an Inspection/Automatic switch, and Emergency Stop switch.
3. Operating device contains an audible and visible indicator that fire recall has been initiated.
4. This station is fixed to the car crosshead or may be portable provided the extension cord and housing are permanently attached to the car crosshead.
5. The car will be operated by constant pressure on the appropriate direction button and the Run button simultaneously.
6. Normal operating devices will be inoperative while this device is in use.

T. Emergency Audible Signaling:
1. Provide on top of each elevator.
2. Activation of the Alarm Button or Emergency Stop switch will cause Emergency Audible Signal.
3. Provide auxiliary power supply to provide 1-hour power in the event of normal power loss.

U. Work Light and Duplex Plug Receptacles:
1. GFCI protected outlet at top and bottom of car.
2. Include on/off switch and lamp guard.
3. Provide additional GFCI protected circuit and dedicated junction box on car top for installation of car CCTV.
4. Provide additional GFCI protected circuit and dedicated junction box on car top for installation of car digital video display.

2.14 CAR ENCLOSURE

A. Passenger Elevators: Provide complete as specified herein and detailed on architectural drawings.
1. Shell:
a. Reinforced formed furniture steel panels with baked enamel interior finish.
b. Apply sound-deadening mastic to exterior.
c. Provide concealed ventilation cutouts.
2. Canopy:
a. Reinforced formed furniture steel panels with lockable, contacted, hinged emergency exit.
3. Front, and Rear for Elevator 1, Swing Return Panels and Integral Entrance Columns:
a. Reinforced furniture steel clad with satin finish stainless steel.
b. Swing entire unit on substantial pivot points for service access to car operating panels.
c. Locate pivot points to provide full swing of return panel without interference with side wall finish or handrail.
d. Secure in closed position with concealed three-point latch.

e. Provide firefighters' and service compartments with recessed flush cover and cutouts for operating switches.

4. Transom: Reinforced furniture steel clad with satin finish stainless steel full width of enclosure.
5. Base: Stainless Steel with concealed ventilation cutouts.
6. Finish Floor Covering:
   a. Furnished under other sections.
   b. Accommodate floor and subfloor thickness.
7. Interior Wall Finish:
   a. Removable panels faced and edged, with textured finish stainless steel, 5WL as manufactured by Rigidized Materials.
8. Forced Ventilation:
   a. Three-speed blower mounted to car canopy.
   b. Exhaust blower meets noise and vibration criteria.
9. Lighting: Provide LED fixtures with wiring and hookup. Coordinate with emergency lighting requirements.
10. Suspended Ceiling: Six-Section Stainless Steel panels with lighting cutouts in each panel.
11. Handrails/Guard Rail:
    a. Two lines.
    b. Top handrail line minimum 1½" diameter stainless-steel grab bar with backing plates and captive nuts.
    c. Lower guardrail line 4" x 3/8" solid stainless-steel flatstock bars mounted on both sides and rear of the car.
    d. Locate bottom guardrail line at 8" above car floor and handrail line at 32" above the car floor.
    e. Bolt rails through car walls from back and mount on 1½" deep solid round stainless-steel standoff spacers no more than 18" O.C.
    f. Return handrail/guardrail ends to car walls.
12. Pads and Buttons, All Cars:
    a. Three-piece removable pads.
    b. Two pads covering side walls and adjacent front returns and one covering rear wall.
    c. Provide cutouts to access main car operating panel.
    d. Isolate from car top to comply with noise and vibration requirements.

2.15 HALL CONTROL STATIONS

A. Pushbuttons:
1. Provide one pushbutton riser.
2. Provide flush mounted faceplates stations at all floors.
3. Include pushbuttons for each direction of travel that illuminate to indicate call registration.
4. Include variable message system at all evacuation and primary egress levels.
5. Include engraved message and pictorial representation prohibiting use of elevator during fire or other emergency as part of faceplate.
6. Pushbutton design matches car operating panel pushbuttons.
7. Provide vandal resistant pushbutton and light assemblies.
8. Provide LED illumination.

9. Provide Phase I Fire Service key switch, engraved operating instructions and illuminating jewel.
10. Provide communication check failure indication and silence key switch.
11. Provide illuminating jewels indicating standby power status.
12. Incorporate all items required by Code at the primary egress level into a single hall fixture.

B. Phase I Fire Service Fixture: Provide separate fixture including key switch, engraved operating instructions, and illuminating jewel. Provide illuminating jewels indicating standby power status.

2.16 SIGNALS

A. Car Direction Lantern:
1. Provide flush-mounted car lantern in all car entrance columns.
2. Illuminate up or down LED lights and sound tone once for up and twice for down direction.
3. Illuminate light until the car doors start to close.
4. Sound level is adjustable from 20-80 dBA measured at 5'-0" in front of hall control station and 3'-0" off floor.
5. Provide advanced hall lantern notification to comply with ADA hall call notification time.
6. Car direction lenses are arrow shaped without faceplates.
7. Lenses are minimum 2½" in their smallest dimension.
8. Provide vandal resistant lantern and light assemblies consisting of series of dots or lines for maximum visibility.

B. Car Position Indicator:
1. Alpha-numeric LCD screens containing floor designations and direction arrows a minimum of 2" high to indicate floor served and direction of car travel.
2. Locate fixture above each car operating panel.
3. When a car leaves or passes a floor, illuminate indication representing position of car in hoistway.
4. Illuminate proper direction arrow to indicate direction of travel.

C. Fixture Faceplate Material and Finish:
1. Satin finish stainless steel, all fixtures.
2. Tamper resistant fasteners for all public facing fastenings.

D. Floor Passing Tone: Provide an audible tone of no less than 20 decibels and frequency of no higher than 1500 Hz, to sound as the car passes or stops at a floor served.

E. Voice Synthesizer: Provide electronic device with easily reprogrammable message and female voice to announce car direction, floor, emergency exiting instructions.

2.17 COMMUNICATION

A. Car Communication System:
1. Hands-Free Phone System:

a. Two-way communication instrument in car with automatic dialing, tracking, and recall features, with shielded wiring to car controller in control room.
b. Provide dialer with automatic rollover capability with minimum two numbers:
    1) Actuate two-way communication via “Help” button.
    2) Adjacent light jewel illuminates and flash when call is acknowledged.
    3) Button matches car operating panel pushbutton design.
    4) Provide “Help” button tactile symbol, engraved signage, and Tactile marking adjacent to button mounted integral with car front return panel.

2. Emergency Personnel Communication:
    a. Communication system is provided allowing emergency personnel to establish communications with each elevator individually.
    b. Emergency Personnel Communication overrides any existing connection outside of building.
    c. Adjacent light jewel illuminates and flashes when call is acknowledged.
    d. Provide operating instructions.
    e. On the same car operating panel as the phone push button, provide capability to communicate with and obtain responses from passengers.
    f. Provide display video capability for entrapment assessment.
3. Communication for deaf, hearing and speech impaired:
    a. On the same car operating panel as the phone push button, provide capability to communicate visually with and obtain responses from passengers, including those passengers who cannot communicate verbally or hear.
    b. Provide shielded twisted pair wiring to communicate to control room network box.
    c. Device shall be open-sourced and capable of being monitored by any entity as selected by the owner. All software, hardware, and training cost associated with the device shall be included within this project. Associated monthly monitoring costs will not be accepted.

B. Remote Monitoring:
1. Provide system to capture faults or system shutdowns in real-time occurrence.
2. Communicate faults or shutdowns to reception system, enabling automatic dispatch of technicians.
3. System monitors faults 24-hours per day, 7-days per week.

C. Client Interface Tool:
1. Provide access to real-time data for elevators, including the following:
    a. Complete service history for all vertical transformation.
    b. Key performance indicators.
    c. Access to service request logs, disposition, and total downtime.
    d. Create service requests.
    e. View customer contracts.
    f. View and/or accept Work Orders.
    g. Provide document repository.
2. Data is accessible from any device, including mobile.

3. Proper safeguards are confirmed, protecting clients from malware and virus receipt.

D. Remote Maintenance (IOT):
1. Enable component performance data capture of information provided through elevator monitoring systems.
2. Perform data analysis to determine maintenance requirements and schedule those maintenance activities.
3. Analyzed data does not alleviate the need to provide maintenance and repairs in accordance with the Maintenance Control Program (MCP), specifically expand timeframes or scheduling for maintenance tasks, but may reduce the timeframe between maintenance tasks as deemed necessary based on, but not limited to:
   a. Cycles.
   b. Voltages.
   c. Resistance.
   d. Delay.
4. System does not allow remote maintenance or the ability to login remotely and affect changes to the operability of the elevator system.

E. Firefighters' Key Box:
1. Flush-mounted box with lockable hinged cover.
2. Engrave instructions for use on cover per Local Fire Authority requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to beginning installation of equipment examine hoistway and control room areas.

B. Verify no irregularities exist that affect execution of work specified.

C. Verify electrical power location and characteristics in coordination with equipment requirements.

D. Do not proceed with installation until work in place conforms to project requirements.

3.2 INSTALLATION

A. Install all equipment in accordance with Contractor's instructions, referenced codes, specification, and approved submittals.

B. Install control room equipment with clearances in accordance with referenced codes and specification.

C. Install all equipment so it may be easily removed for maintenance and repair.

D. Provide any required hoisting/safety beams.

E. Install all equipment to afford maximum accessibility, safety, and continuity of operation.

F. Remove oil, grease, scale, and other foreign matter from the following equipment and apply one coat of field-applied machinery enamel.
   1. All exposed equipment and metal work installed as part of this work which does not have architectural finish.
   2. Control room equipment, hoistway equipment including guide rails, guide rail brackets, and pit equipment.
   3. Neatly touch up damaged factory-painted surfaces with original paint color. Protect machine finish surfaces against corrosion.

G. Fill hoistway door frames, back boxes for hallway stations and signal devices, and sills.

H. Clean all architectural finishes and replace or restore any surfaces damaged during construction to like new condition.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Operating Test:
   1. Load each elevator to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next.
   2. Record temperature rise of elevator machine during 30-minute test period.
   3. Record failure to perform as required.

C. Advise Contractor, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

D. Independent Testing by Owner’s Consultant.

3.4 CONSTRUCTION TOLERANCES

A. Install rails plumb and align vertically with tolerance of 1/16" in 100'-0".

B. Secure joints without gaps and file any irregularities to a smooth surface.

3.5 ADJUSTING

A. Static balance car to equalize pressure of guide shoes on guide rails.

B. Dynamically balance car and counterweight.

C. Lubricate all equipment in accordance with Contractor’s instructions.

D. Adjust motors, power conversion units, brakes, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks, and safety devices to achieve specified performance levels.

3.6 CLEANING

A. Keep work areas orderly and free from debris during progress of project.

B. Remove packaging materials on a daily basis.

C. Remove all loose materials and filings resulting from work.

D. Clean control room equipment and floor.

E. Clean hoistways, car, car enclosure, entrances, operating and signal fixtures.

F. Clean pit equipment and floor.

3.7 DEMONSTRATION:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate all aspects of elevators while in normal operation.

B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period.

C. Determine that operation systems and devices are functioning properly.

3.8 PROTECTION

A. Temporary Use: Comply with the following requirements for each elevator used for construction purposes:
   1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
   2. Provide strippable protective film on entrance and car doors and frames.
   3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
   4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
   5. Do not load elevators beyond their rated weight capacity.
   6. Engage elevator Installer to provide full maintenance service.
      a. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity.
      b. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
   7. Engage Elevator Installer to restore damaged work, if any, so no evidence remains of correction.
   8. Return items which cannot be refinished in the field to the shop, make required repairs, and refinish entire unit, or provide new units as required.

END OF SECTION

Division 21 - WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the GENERAL CONDITIONS, SUPPLEMENTARY CONDITIONS, AND DIVISION 1, GENERAL REQUIREMENTS, apply to the work of this SECTION.

1.2 DESCRIPTION

A. Design and furnish all materials, labor, and equipment necessary for the installation of hydraulically designed Automatic Fire Sprinkler System throughout the buildings as generally outlined in this schematic performance Specification including but not limited to the following:

1. These systems will have to be reviewed and approved by the Division of The State Architect.
2. Overhead work shall begin 6” above finished floor. See Site Fire Protection piping supplying the Overhead Fire Sprinkler Systems as well as the supply and discharge overhead supply to the fire pump. Fire department connections are a part of the overhead. Refer to Site Fire Plan.
3. Occupancy and hazard classifications of each area shall be as per NFPA 13 and Division of The State Architect.
4. Furnish electric bells. Alarm and equipment location to be approved by the Architect. Coordinate installation (by others).
5. Sprinkler system shall be provided with floor control valves with tamper switches, electrical flow switches and test and drain valves on each floor.
6. Tamper switches at all valves as required.
7. Coordinate with Electrical Contractor for all necessary wiring and power supply.

8. Coordinate with structural engineer and architect for all penetration and sleeve locations. Post tension concrete slabs shall not be penetrated without the written approval by the structural engineer. Sleeves and layout of sleeves shall be included. GC shall provide control layout.
9. Sprinkler heads shall be provided in all mechanical equipment rooms, including telephone and electrical rooms, electrical switchgear rooms, and elevator machine rooms.
10. Flow and tamper switches shall be provided to accommodate monitoring by a central station.
11. One-year warranty.

1.3 PROPOSALS

A. Proposals include the cost of design and installation of the work described in this Section and any other systems and components required for a complete and functional Fire Protection system. The plans accompanying this specification are preliminary and are not to be presumed as complete and final. Changes to the project which may include Applications for Alternate Means and Methods, architectural design changes, structural design changes, may incur a change order by the subcontractor

1.4 DESIGN PROCEDURE

A. Complete working drawings per established schedules for construction and submittal to Division of The State Architect. Include coordination with Architect as to location of roof and floor openings and beam penetrations, location and weight of all equipment, and other pertinent features of the sprinkler design, including size, location and type of access panels, which might affect structural and/or architectural design.

B. Engineering calculations and construction drawings shall be prepared by a competent fire sprinkler designer under the review of a State of California C16 Licensed Fire Sprinkler Contractor. The calculations shall be based on NFPA 13.

C. At conclusion of base building construction, contractor shall provide hard copy and digital copies of as-built fire sprinkler drawings reflecting the actual installation.

1.5 SCOPE OF WORK COORDINATION

A. This section is provided in order to clarify additional work required by other trades.

B. Plumbing Subcontractor: The plumbing subcontractor shall furnish primed sanitary sewer drains at the base of fire sprinkler risers.

C. Electrical Subcontractor: The electrical subcontractor shall wire all tamper switches, water flow switches, fire pump, jockey pump, main controller, jockey controller, and appurtenances.

D. Wall and Ceiling Subcontractors

1. Access doors: Access doors in architectural walls and ceilings shall be provided by the wall or ceiling contractor where they are identified on fire protection drawings with a reference to same in architectural bid documents. The fire protection contractor shall locate and size all access doors relating to his work.

E. HVAC Subcontractor: Coordination of piping and ductwork: Ductwork takes priority over sprinkler piping unless transitions in piping create an offset below other piping that cannot be easily drained.

F. Miscellaneous Subcontractors or General Contractor:

1. Floor openings: The fire protection contractor shall locate and size all floor openings for piping and provide cans for same, except architectural shafts shown on architectural drawings. .

2. Equipment pads: The fire protection contractor shall locate and dimension all concrete bases and housekeeping pads relating to his work, to be provided by others.

3. Hoisting: Hoisting of all equipment, men and materials shall be coordinated. The Fire Sprinkler contractor shall provide all necessary rigging, supervisory labor and coordinate for hoisting only during normal working hours

1.6 SUBMITTALS

A. Submit Shop Drawings and Material Submittals to the Architect for approval.

B. Make all submittals sufficiently in advance of field requirements to allow ample time for checking.

C. Prepare and submit reproducible shop drawings and prints of all plans, sections, details and diagrams to minimum scale 1/8” = 1’ – 0”. Rooms and/or details shall be 1/4” = 1’0” minimum scale

1.8 UTILITY

A. For water supply, refer to the Underground Fire Protection and the Site Fire Protection plan. – Document TBD

1.9 REFERENCE STANDARDS AND CODES

A. Fire sprinkler system shall conform to the applicable requirements of the Building Codes, NFPA, Division of The State Architect Department requirements, State and Local Fire Marshal, and other applicable ordinances and codes.

1.10 GUARANTEE

A. The entire installation shall be guaranteed by the Contractor for a period of one year including repair and damage caused by leaks.

1.11 PRODUCT HANDLING AND STORAGE

A. Protect the Fire Sprinkler System materials from damage prior to installation. Protect the installed work of other trades.

1.12 EXTRA STOCK

A. Furnish extra sprinklers of each different type as required by NFPA 13 in a spare sprinkler cabinet with a special sprinkler wrench for each type.

1.13 TRENCHING AND BACKFILLING

A. Refer to the Underground Fire Protection.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Piping 3” and larger Black Schedule 10 ASTM UL /FMG approved. Per district specs.
B. Piping 1”-2½” Schedule 40 ASTM UL /FMG approved Per district specs.
C. Fittings for Steel Piping: Threaded fittings shall be UL/FMG approved 150 lb. minimum ductile/cast iron, or UL/FMG approved. Grooved fittings shall be UL/FMG approved and minimum 175 psi minimum rated.

2.2 VALVES

A. Fire sprinkler control valves shall be UL/FMG grooved butterfly valves except where OS & Y gate valves are required before pumps per NFPA 20.

B. Check Valves shall be UL/FMG with grooved ends.

2.3 SPRINKLERS

A. Sprinkler heads shall be of the temperature rating and type as required. Provide quick response type as required. Provide sprinkler cage for exposed heads at 7 feet or lower elevations that are subject to damage.

B. Sprinkler head shall be located as indicated on the architectural drawings, or in cases where they are not indicated, as required by code and approved by the Architect. Additional sprinklers needed to meet aesthetic requirements are excluded.

C. Core ceiling sprinklers shall be white semi-recessed with white escutcheons.

D. Attic sprinklers shall be rough brass finish.

E. Exterior sprinklers shall have a white corrosion resistant coating.

F. Concealed ceiling sprinklers may be provided as an alternate for change where requested.

2.4 DRAIN AND TEST CONNECTIONS

A. Systems shall be installed to drain per where required per NFPA 13 with valves and piping of size as approved in accordance with NFPA 13. Drain risers capable of handling flow from hose valve test and equipped with connection for same shall be provided

2.5 KEY PLAN

A. Provide a key floor plan in frame showing locations of all standpipes and shut-off valves in a fire control room.

2.6 TAMPER SWITCHES, & FLOW SWITCHES

A. Tamper switches and flow switches shall be provided as per code.

2.7 STANDPIPE ACCESSORIES

A. Angle Hose: Potter Roemer, Croker, FPPI, or equal rough brass Gr. Or MNST X FNPT.
B. FDC: Potter Roemer, Croker, FPPI, or equal rough brass FNST X MNPT
C. Roof Connections: Two-Way rough brass by Potter Roemer, Croker, FPPI or equal.

PART 3 - EXECUTION

3.1 FABRICATION

A. All materials shall be new and as approved. All piping shall be reasonably free of rust. All fabrication shall be in compliance with the approved shop drawings.

3.2 INSPECTION

A. Prior to the commencement of each stage of the Fire Sprinkler System installation, carefully inspect the installed work of other trades and determine that all such work

is sufficiently complete to allow this installation to begin and that the work of other trades has been installed in such a manner as to permit this installation to be made in complete accordance with the approved design.

3.3 COORDINATION

A. Coordinate the installation schedule for this portion of the work with the overall construction schedule for the work to ensure orderly progress of the work with an absolute minimum of delay.

B. Coordinate interface of the Fire Sprinkler System with the work of all other trades to ensure proper and adequate provision for the installation and connection of this system.

3.4 INSTALLATION

A. Install the complete Fire Sprinkler System in strict accordance with the approved shop drawings.

B. Piping shall be concealed in all finished areas. Piping in exposed areas (areas without ceiling) and parking garage shall be exposed.

C. Where piping passes through rated walls, floors, or ceiling penetrations shall be fire-stopped.

D. Provide earthquake protection and bracing as required by NFPA 13.

E. Furnish all access doors for the work of the Section, Label per NFPA 13.

F. Piping shall be located under beams rather than through beams or columns whenever possible.

G. Install UL hangers, earthquake bracing, and branch-line restraints.

I. Set sprinkler heads at finished ceiling height where ceiling is in contract.

3.5 TESTS

A. Prior to connection to the overhead sprinkler piping, the site contractor should provide documentation showing the underground main was flushed and tested in the presence of the local fire inspector and met with his approval.

3.6 ACCEPTANCE AND INSTRUCTIONS

A. After completion of all installation, tests, etc., and prior to the opening date, instruct the Owner's representative in the operation of the sprinkler system and fire pump.

3.7 CLEANING UP

A. Upon completion of the work completely remove all debris and excess materials from the job site.

END OF DIVISION 21

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.

1.2 SUBMITTALS

B. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVE-SEAL SYSTEMS

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. Link-Seal.
   2. Metraflex Company (The).
   3. Pipeline Seal and Insulator, Inc.
   4. 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.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade (when penetrations are below exterior finish grade elevation) 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.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

1.2 Section Includes:
1. Escutcheons.
2. Floor plates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, steel. With chrome finish.

B. Two-Piece, steel. With chrome finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, and ceilings in normally occupied rooms.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Bimetallic-actuated thermometers.
2. Thermowells.
3. Dial-type pressure gauges.
4. Gauge attachments.
5. Water meters

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product certificates.

C. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

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. Palmer Wahl Instrumentation Group.
2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
3. Weiss Instruments, Inc.

B. Standard: ASME B40.200.

C. Case: sealed type(s); stainless steel with 5-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass .

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 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 or CUNI.
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.

2.3 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
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. Palmer Wahl Instrumentation Group.
b. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
c. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Sealed type(s); 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, 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: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 WATER METERS

A. Positive displacement water meter.
   1. Min accuracy: Within 5% of minimum and maximum rated flow listing.
   2. Material: Low lead bronze or epoxy coated cast iron.

PART 3 - EXECUTION

3.1 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 direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

G. Install snubber in piping for each pressure gauge for fluids.

H. Adjust faces of meters and gauges to proper angle for best visibility.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze swing check valves.
4. Iron swing check valves.

B. Related Sections:
1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

C. Applications:
1. Domestic cold water.
2. Domestic hot water/hot water return.

1.2 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

C. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Valve Sizes: Same as upstream piping unless otherwise indicated. In no case shall valves be smaller than equipment point of connection.

B. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.
4. Press-Fit: With female press end connections, according to ASME A112.4.14.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim, Lead Free:
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. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
2. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 250 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded, soldered or press-fit.
f. Seats: PTFE or TFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass or stainless.
i. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc, Lead Free:
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. Crane Co.; Crane Valve Group; Jenkins Valves.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
2. Description:
a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.
h. Body seal: EPDM.

2.4 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Lead Free:

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. Crane Co.; Crane Valve Group; Crane Valves.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
2. Description:
   a. Standard: MSS SP-80.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded or soldered.
   f. Disc: Bronze.

2.5 IRON SWING CHECK VALVES

A. Iron Swing Check Valves with Metal Seats, Lead Free:
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. Crane Co.; Crane Valve Group; Crane Valves.
   b. Hammond Valve.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
2. Description:
   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2" to NPS 12", CWP Rating: 200 psig.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 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.

3.2 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. Valves installed in horizontal piping shall have stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Pipe NPS 2” and Smaller: Ball valves.

B. Pipe NPS 2-1/2 and Larger: Butterfly valves.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Pipe positioning systems.
5. Fastener systems.
6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports, including bracing and other restraints, for plumbing piping and equipment shall withstand the effects of gravity, thermal, and seismic loads within limits and under conditions indicated according to 2019 CBC.
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.
4. Seismic design criteria per structural drawings.
5. Design piping systems to accommodate thermal changes without impact to serviceability.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Welding certificates.

C. Seismic bracing plans, details, and structural calculations

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, and MSS SP-69.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Padded Hangers: Hanger with felt to support bearing surface of piping for non-insulated copper piping.

4. Hanger Rods: Zinc-plated, continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

A. Carbon-Steel Trapeze Pipe Hangers:
   1. Description: MSS SP-58, and MSS SP-69.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength and A-527 Galvanized sheet metal jacket.

B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

C. For Clevis, Band or J-Hangers: Insert and shield shall cover lower 180 degrees of pipe.

2.4 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: See mechanical details and structural details on plans.

2.5 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.

2.6 EQUIPMENT SUPPORTS

A. Description: See mechanical details and structural details.

PART 3 - EXECUTION

3.1 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.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. 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.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. 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.

H. Install building attachments within concrete slabs or attach to structural steel.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. 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.

K. 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.

3.2 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.3 HANGER AND SUPPORT SCHEDULE

A. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

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 and metal trapeze pipe hangers and attachments for general service applications.

E. Use padded felt lined hangers and clamps where applicable to prevent electrolysis between dissimilar metals.

F. Use thermal-hanger shield inserts for insulated piping and tubing.

G. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

H. Horizontal-Piping Hangers and Supports: Support piping per 2019 CBC, and 2019 CMC requirements (including seismic requirements).

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Pipe labels.

1.2 SUBMITTAL

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black .
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
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: 1/2 inch.
7. Adhesive (when not attached by screws): Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, 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.

2.3 CEILING TAGS:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 1" by 1/2 inch.
6. Minimum Letter Size: 1/4 inch.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

PART 3 - EXECUTION

3.1 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.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. 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. At access doors, manholes, and similar access points that permit view of concealed piping.
   2. Near major equipment items and other points of origination and termination.
   3. Spaced at maximum intervals of 50 feet.
   4. Provide flow directional arrow minimum 1 at each label.

3.4 CEILING TAG INSTALLATION

A. Install labels on t-bar ceiling grid, or access door for each of the following:
   1. Main plumbing shutoff valves above ceiling.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Glass Fiber.
      b. Flexible elastomeric.
   2. Adhesives.
   3. Sealants.
   4. Factory-applied jackets.
   5. Field-applied jackets.
   6. Tapes.
   7. Securements.

B. Related Sections:
   1. Division 23 Section "Mechanical Insulation."

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting agency.
   1. Insulation Installed Indoors and outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Glass Fiber: Inorganic, incombustible, molded heavy density resin. Factory-applied all service jacket.
   1. Products: Provide the following or equal:
      a. “Owens Corning” ASJ/SSL II, complying with ASTM C547.

D. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products: Provide one of the following or equal:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.

2.2 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. Products: Subject to compliance with requirements, provide the following] [provide one of the following:
      a. Aeroflex USA Inc.; Aeroseal.
      b. Armacell LCC; 520 Adhesive.
      c. Foster Products Corporation, H. B. Fuller Company; 85-75.
   2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; CP-82.
      b. Foster Products Corporation, H. B. Fuller Company; 85-20.
   2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Chemical Company (The); 739, Dow Silicone.
      b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
      c. P.I.C. Plastics, Inc.; Welding Adhesive.
      d. Speedline Corporation; Speedline Vinyl Adhesive.
   2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; CP-76-8.
      b. Foster Products Corporation, H. B. Fuller Company; 95-44.
      c. Marathon Industries, Inc.; 405.
   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
   5. Color: Aluminum.
   6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto PVC Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. 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.

C. Aluminum Jacket: Comply with ASTM B 209 Alloy 3003, 3005, 3105 or 5005, Temper H-14. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; Metal Jacketing Systems.
      b. PABCO Metals Corporation; Surefit.
      c. RPR Products, Inc; Insul-Mate.
   2. 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.

2.5 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches (75 mm).
   3. Thickness: 11.5 mils (0.29 mm).

2.6 SECUREMENTS

A. Aluminum Bands: ASTM B 209 Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products; Bands.
      b. PABCO Metals Corporation; Bands.
      c. RPR Products, Inc.; Bands.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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. Keep insulation materials dry during application and finishing.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
   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.

G. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

H. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

I. For above ambient services, do not install insulation to the following:
   1. Testing agency labels and stamps.
   2. Nameplates and data plates.
   3. Manholes.

J. Equipment requiring insulation:
   1. Water heating equipment (if not factory insulated).
   2. Exposed Lavatory P-traps and Hot Water Supply piping.

3.3 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.
   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 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.
   5. 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.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment.

3.4 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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.

3.5 GLASS FIBER INSULATION INSTALLATION

1. Secure pipe insulation per manufacturer's recommendations.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are installed, install with 1-inch 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.

B. Where metal jackets are installed, 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 aluminum bands 12 inches o.c. and at end joints.

3.7 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating where located outdoors.

3.8 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold and non-potable within the building for condensation control: Insulation shall be the following:
   1. Glass-Fiber: 1" thick min, Preformed Pipe Insulation, Type I:
   2. Flexible Elastomeric: 1/2" thick insulation.

B. Condensate lines within the building for condensate control: Insulation shall be the following:
   1. Glass-Fiber, Preformed Pipe Insulation, Type I:
      a. All pipe sizes = 1" thick insulation.

C. Domestic Hot and Recirculated Hot Water: Insulation shall be the following:
   1. Glass-Fiber, Preformed Pipe Insulation, Type I:
      a. Pipe sizes 3/4" and less = 1" thick insulation.
      b. Pipe sizes 1" and larger = 1-1/2" thick insulation.

D. Roof Drain and Overflow Drain: Bodies of drains and downstream horizontal piping up to the point that piping turns vertical to drop to floor below, insulation shall be one of the following:
   1. Flexible Elastomeric: 1/2" thick insulation.
   2. Glass-Fiber: 1-1/2" thick duct wrap insulation.

3.9 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Hot Water Piping: Insulation shall be the following:
   1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1" thick insulation.

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install the field-applied jacket over the factory-applied jacket.

B. Piping, Exposed in Mechanical Rooms and other visible spaces without ceilings:
   1. PVC: 20 mils thick.

C. Piping accessible to students:
   1. Aluminum 0.016” thick. Stucco Embossed Finish

3.11 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, Exposed:
   1. Aluminum 0.016” thick. Stucco Embossed Finish

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Above and below ground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Flexible connectors.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to 2019 CBC requirements. This is designed by Mason Industries, see seismic drawings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail, at ¼" per foot, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 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.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Wrought-Copper Press Fit Fittings: ASME B16.22, wrought-copper mechanical press fittings.

3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint or mechanical press ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint, threaded or mechanical press ends.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Wrought-Copper Press-Fit Fittings: ASME B16.22, wrought-copper mechanical press fittings.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, Aramid fiber with nitrile binder, Garlock 2550 or equal.

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. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

E. Gasket Material: Thickness, material and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Flanges:
1. Description:
a. Manufacturer: CTS
b. Factory-fabricated, bolted, companion-flange assembly, UL Listed.
c. Pressure Rating: 150 psig minimum.
d. End Connections: Solder-joint or mechanical press copper alloy.
e. EPDM insulator.

C. Dielectric Nipples:
1. Description:
a. Manufacturer: Perfection Corp – Clearflow
b. Electroplated steel nipple complying with ASTM F 1545.
c. Pressure Rating: 300 psig at 225 deg F.

d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

2.5 FLEXIBLE CONNECTORS

A. 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 150 psig.
2. End Connections NPS 2” and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2” and Larger: Flanged steel nipple.

B. Manufacturers:
1. Metraflex, Inc.
2. Unaflex, Inc.
3. Unisource, Inc.
4. Or equal

PART 3 - EXECUTION

3.1 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 water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

D. Install domestic water piping level and plumb, unless indicated otherwise.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

H. Install piping adjacent to equipment and specialties to allow service and maintenance.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections. “T-Drill” fittings are acceptable with brazed joints.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.2 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 pipes, tubes, and fittings before assembly.

C. 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.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: 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."

F. 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.

G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

3.4 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 flanges.

3.5 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.

B. Install stainless-steel-hose flexible connectors with dielectric flanges in domestic water piping.

C. Install flexible connections as shown on plans.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. 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:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. 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.
3. 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.
4. Cap and subject piping to static water pressure of 125 psig. Isolate test source and allow to stand for two hours minimum. Leaks and loss in test pressure constitute defects that must be repaired.
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 for corrective action required.
7. Demonstrate to owner representative and/or inspector of record for approval.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 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, as summarized below:
a. Inspect results from system purge to ensure material integrity and removal of system contaminants that may have entered the system.
b. Chlorinate system by methods as described in AWWA C651 standard (Liquid chlorine, sodium hypochlorite, calcium hypochlorite). Method must be approved by design team prior to acceptance of process.
c. Document that an adequate level of chlorine contacted each pipe to provide disinfection. Ensure that dosage and duration requirements for proper disinfection are met.
d. Flush and purge all hyper-chlorinated waters from the system to chlorine levels that are consistent with incoming city water.

e. Determine bacteriological quality (coliform and heterotrophic bacteria) by independent certified laboratory test after the disinfection process.

B. Prepare and submit reports of purging and disinfecting activities.

3.10 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 8”and smaller, shall be one of the following:
1. ASTM B 88, Type K; wrought-copper brazed joint fittings.

D. Under-building-slab, domestic water piping, NPS 1” and smaller shall be one of the following:
1. Hard or soft copper tube, ASTM B 88, Type K; wrought-copper fittings with brazed joints.

E. Aboveground domestic water piping, NPS 2” and smaller, shall be:
1. Hard copper tube, ASTM B 88, Type L; wrought copper solder-joint fittings; and soldered or brazed joints or wrought copper mechanical press fittings.

F. Aboveground domestic water piping, NPS 2-1/2” and larger shall be:
1. Hard copper tube, ASTM B 88, Type L; wrought copper solder-joint fittings; brazed joints, or wrought copper mechanical press fittings (up to and including 4” NPS)

3.11 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball valves for piping NPS 2” and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
2. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following domestic water piping specialties:
   1. Backflow preventers.
   2. Water pressure-reducing valves.
   3. Balancing valves.
   4. Strainers.
   5. Hose bibbs.
   6. Water hammer arresters.
   7. Trap-seal primer valves.
   8. Outlet boxes (ice maker boxes).

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 150 psig, unless otherwise indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. NSF Compliance:
   1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Co.
      b. Conbraco Industries, Inc.
      c. FEBCO; SPX Valves & Controls.
      d. Watts Industries, Inc.; Water Products Div.
      e. Zurn Plumbing Products Group; Wilkins Div.
   2. Standard: ASSE 1001.
   3. Body: Bronze.
   4. Inlet and Outlet Connections: Threaded.
   5. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.
b. MIFAB, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Woodford Manufacturing Company.
e. Zurn Plumbing Products Group; Light Commercial Operation.
f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.
b. FEBCO; SPX Valves & Controls.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.
2. Standards: ASSE 1013.
3. Listing: UPC.
4. Body: Bronze for NPS 2” and smaller; FDA epoxy coated cast iron for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2” and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal flow.
7. Accessories:
a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
8. Location: install between 1’-0” and 5’-0” above finished floor. If mounted above 5’-0” a platform is required per 2016 CPC.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.
c. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Manufacturers:
1. Bell & Gossett
2. Watts
3. Armstrong

2.4 BALANCING VALVES

A. Memory-Stop Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. B&G.
2. Pressure Rating: 200-psig minimum at 250 deg F.
3. Size: NPS 2” and smaller.
4. Body: Bronze.
5. Port: Full port.
6. Ball: Brass or chrome-plated brass.
7. End Connections: Solder joint or threaded.

B. Automatic Balancing Valves:
1. Manufacturers:
   a. Victaulic
2. Pressure Rating: 400 psi at 180 deg F.
3. Size: ¾” and smaller
4. Body: Series 300 Stainless Steel
5. End Connections: Threaded

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze.
3. End Connections: Threaded for NPS 2” and smaller; flanged for NPS 2-1/2”and larger.
4. Screen: Stainless steel with round perforations.

5. Drain: Provide ball valve with hose end at each strainer.

B. Manufacturers:
1. Watts.
2. IFC.
3. Armstrong.

2.6 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company.
b. MIFAB, Inc.
c. PPP Inc.
d. Sioux Chief Manufacturing Company, Inc.
e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Copper tube with piston.

2.7 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. MIFAB, Inc.
b. PPP Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS ½" threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS ½" threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.8 OUTLET BOXES

A. Outlet Boxes
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Engineering Company.

b. Guy Gray Manufacturing Co., Inc.
c. Bradely
2. Mounting: Recessed.
3. Material and Finish: Stainless-steel box.
4. Faucet: Separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.

2.9 HOSE BIBBS

A. Hose Bibbs:
1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
5. Pressure Rating: Min 125 psig.
6. Vacuum Breaker: Integral hose-connection vacuum breaker complying with ASSE 1011.
7. Finish: See plans.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and/or 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 in serviceable location.
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 not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install balancing valves in locations where they can easily be adjusted.

C. Install water hammer arresters in water piping according to PDI-WH 201.

D. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
1. Contractor to test each reduced-pressure-principle backflow preventer and provide certification and submit test to owner representative.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

C. Clean strainers after start-up.

3.3 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow of balancing valves.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building and outside the building up to connection to Civil plans.
   1. Pipe, tube and fittings.

1.2 SUBMITTALS

A. Field quality-control inspection and test reports.

B. Product data sheets.

C. Shop Drawings: Detail, at ¼" per foot, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, and attachments of the same to the building structure. Detail location of anchors.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
   1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
      a. Standard Duty Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices and ASTM C 564, rubber sleeve.
      b. Heavy-Duty Couplings: Husky HD 2000 or equal, ASTM C1540 and ASTM C564, with stainless-steel shield, stainless-steel bands and tightening devices, and rubber sleeve.

B. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
   1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Aboveground, sanitary waste piping shall be any of the following:
   1. Hubless cast-iron soil pipe and fittings; heavy duty couplings, and hubless-coupling joints.

2. Copper DWV tube, copper drainage fittings, and soldered joints (for trap arms, connection to fixtures, and in tight spaces).

B. Aboveground sanitary vent piping shall be any of the following:
   1. Hubless cast-iron soil pipe and fittings; shielded, standard duty stainless-steel couplings; and hubless-coupling joints.
   2. Copper DWV tube, copper drainage fittings, and soldered joints.

C. Underground, soil, waste, and vent piping shall be:
   1. Hubless cast-iron soil pipe and fittings; heavy duty stainless-steel couplings; and hubless-coupling joints.

3.2 PIPING INSTALLATION

A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

B. 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."

C. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   2. Vent Piping: May be installed with no slope if above the floor rim of fixture served. Otherwise, vent piping shall be sloped 1 percent downward.

D. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

E. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Submit request for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Refer to Division 1 Inspection Notification 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 the following procedures:
   1. Duration – 4 hours with water at minimum 10-foot head.
   2. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   3. Prepare reports for tests and required corrective action.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Miscellaneous sanitary drainage piping specialties.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. Zurn.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
   2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
   3. Size: Same as connected drainage piping
   4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
   5. Closure: Countersunk or raised-head brass or bronze plug.

B. Cast-Iron Floor Cleanouts:
   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. Josam Company; Josam Div.
      b. Sioux Chief Manufacturing Company, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Watts Drainage Products Inc.
      e. Zurn Plumbing Products Group; Light Commercial Operation.
   2. Standard: ASME A112.36.2M for adjustable housing cleanout.
   3. Size: Same as connected branch.
   4. Type: Threaded, adjustable housing.
   5. Body or Ferrule: Cast iron

6. Closure: Countersunk or raised-head brass or bronze plug.
7. Adjustable Housing Material: Cast iron.
8. Frame and Cover Material and Finish: Rough bronze.
9. Frame and Cover Shape: Round or square to match floor.

C. Cast-Iron Wall Cleanouts:
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. Josam Company; Josam Div.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Watts Drainage Products Inc.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Cast-iron soil pipe T-branch as required to match connected piping. Option for drilled-and-threaded plug in first subparagraph below is for a screw for a wall cover plate.
5. Closure: Countersunk or raised-head brass or bronze 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. Provide rated access door where necessary.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:
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. Josam Company; Josam Div.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Watts Drainage Products Inc.
   d. Zurn Plumbing Products Group; Light Commercial Operation.
   e. Mason Industries.
2. Standard: ASME A112.6.3.
3. Body Material: Cast iron.
4. Seepage Flange: Required.
5. Anchor Flange: Not required.
6. Top or Strainer Material: Bronze.
7. Top of Body and Strainer Finish: Rough bronze.
8. Top Shape: Round or Square, to match flooring.
9. Trap Material: Cast iron.
10. Trap Features: Trap-seal primer connection as required.
11. For floor drains in floating floor: Drains provided by Mason Industries. See plans.

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 ½" side inlet.

C. Note: CPC listed trap guards are an acceptable alternative to trap primers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following (and as required by the 2007 CPC):
   1. Size same as drainage piping up to NPS 4". Use 4" cleanouts for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 135 degrees.
   3. Locate at minimum intervals of 100 feet of 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. For rated walls, provide rated access doors.

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.
      a. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
      b. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   2. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection or a UPC listed trap guard alternative.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain outlet.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 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

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following storm drainage piping inside the building.
   1. Pipe and fittings.

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water or 5 PSI air.

1.3 SUBMITTALS

A. Field quality-control inspection and test reports.

B. Product data sheets.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
   1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
      a. Heavy Duty Couplings: Husky SD 4000 or equal, with stainless-steel shield, stainless-steel bands and tightening devices, heavy duty FM-1680 compliant, and ASTM C 564, rubber sleeve.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Aboveground storm drainage piping NPS 12 and smaller shall be any of the following:
   1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.

C. Underground storm drainage piping shall be the following:
   1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.

3.2 PIPING INSTALLATION

A. 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."

B. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. 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.

C. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 2 percent downward in direction of flow.
   2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

D. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

E. Install escutcheons for exposed pipe penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 HANGER AND SUPPORT INSTALLATION

A. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

3.5 CONNECTIONS

A. Connect interior storm drainage piping to exterior storm drainage piping. Use approved transition fitting to join dissimilar piping materials.

B. Connect storm drainage piping to roof drains and storm drainage specialties.

3.6 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. Arrange for inspection of piping before concealing or closing-in after roughing-in. Test piping with 10’ head for 15 minutes.

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.

3.7 CLEANING

A. Clean interior of piping. Remove 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.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Faucets for lavatories and sinks.
   2. Flushometers.
   3. Toilet seats.
   4. Fixture supports.
   5. Water closets.
   6. Lavatories.
   7. Sinks.

1.2 DEFINITIONS

A. Accessible Medical Plumbing Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in 2016 C.E.C., by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combination fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
3. Faucets: ASME A112.18.1.
4. Hose-Connection Vacuum Breakers: ASSE 1011.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
7. NSF Materials: NSF 61.
8. Pipe Threads: ASME B1.20.1.
9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
10. Supply Fittings: ASME A112.18.1.
11. Brass Waste Fittings: ASME A112.18.2.

G. Comply with the following applicable standards and other requirements specified for shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Faucets: ASME A112.18.1.
4. Hand-Held Showers: ASSE 1014.
5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Manual-Control Antiscald Faucets: ASTM F 444.
8. Pipe Threads: ASME B1.20.1.
9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Flexible Water Connectors: ASME A112.18.6.
4. Manual-Operation Flushometers: ASSE 1037.
5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
6. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Hose-Coupling Threads: ASME B1.20.7.
2. Off-Floor Fixture Supports: ASME A112.6.1M.
3. Pipe Threads: ASME B1.20.1.
4. Plastic Toilet Seats: ANSI Z124.5.
5. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 2.10 See fixture schedule on Sheet P0.3 for fixtures. Provide listed fixture (or equal).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble medical plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.

E. Install fixtures level and plumb according to roughing-in drawings.

F. Install water-supply piping with stop on each supply to each fixture to be connected to domestic water piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

H. Install flushometer valves for accessible water closets with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

I. Install toilet seats on water closets.

J. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

K. Install shower flow-control fittings with specified maximum flow rates in shower arms.

L. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.

M. Install escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

N. Maintain fire rated wall construction when installing fixtures on rated walls.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from domestic water piping to medical plumbing fixtures.

C. Connect drain piping from medical plumbing fixtures to sanitary waste and vent piping.

3.3 FIELD QUALITY CONTROL

A. Check that medical plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

B. Inspect installed medical plumbing fixtures for damage. Replace damaged fixtures and components.

C. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.4 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVE-SEAL SYSTEMS

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. Link-Seal.
   2. Metraflex Company (The).
   3. Pipeline Seal and Insulator, Inc.
   4. 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.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 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.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One piece, steel. With chrome finish.

B. Two-piece, steel. With chrome finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, and ceilings in normally occupied rooms.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Fastener systems.
   5. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports, including bracing and other restraints, for HVAC piping and equipment shall withstand the effects of gravity, thermal, and seismic loads within limits and under conditions indicated according to 2019 CBC.
   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.
   4. Seismic design criteria per structural drawings.
   5. Design piping systems to accommodate thermal changes without impact to serviceability.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Welding certificates.

C. Seismic bracing plans, details, and structural calculations

1.4 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

2.1 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: Pregalvanized or hot dipped.
3. Padded Hangers: Hanger with felt to support bearing surface of piping.
4. Hanger Rods: Zinc-plated, continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

A. Carbon-Steel Trapeze Pipe Hangers:
1. Description: MSS SP-58, and MSS SP-69.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength and A-527 Galvanized sheet metal jacket.

B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

C. For Clevis or Band Hangers: Insert and shield shall cover at least the lower 180 degrees of pipe.

2.4 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: See mechanical details and structural details.

2.5 EQUIPMENT SUPPORTS

A. Description: See mechanical details and structural details.

PART 3 - EXECUTION

3.1 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.

C. 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.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. 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.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install building attachments within concrete slabs or attach to structural steel.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Install lateral bracing with pipe hangers and supports to prevent swaying where required per code.

J. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Chilled water and heating hot water piping: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      b. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

3.2 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.3 HANGER AND SUPPORT SCHEDULE

A. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

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 and metal trapeze pipe hangers and attachments for general service applications.

E. Use padded felt lined hangers and clamps to prevent electrolysis between dissimilar metals.

F. Use thermal-hanger shield inserts for insulated piping and tubing.

G. Horizontal-Piping Hangers and Supports: Support piping per 2019 CBC, 2019 CMC and 2019 CPC requirements (including seismic requirements).

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Pipe labels.
3. Ceiling tags.

1.2 SUBMITTAL

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
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: 1/2 inch.
7. Adhesive (when not attached by metal): Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings.
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.

2.3 CEILING TAGS:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick.
2. Letter Color: White.

3. Background Color: Fire Smoke Dampers - Red. All others shall be black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 1" by 1/2 inch.
6. Minimum Letter Size: 1/4 inch.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

PART 3 - EXECUTION

3.1 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.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. 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. At access doors, manholes, and similar access points that permit view of concealed piping.
   2. Near major equipment items and other points of origination and termination.
   3. 50 feet intervals.
   4. Provide flow directional arrow minimum 1 at each label.

3.4 CEILING TAG INSTALLATION

A. Install labels on t-bar ceiling grid, or access door for each of the following:
   1. Fire/Smoke Dampers
   2. Constant Air Volume Boxes
   3. Fan Coils above ceiling
   4. Transfer Fans above ceiling
   5. Main hydronic shutoff valves at each floor

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.
      b. Variable-airflow systems.
   2. Balancing Domestic Water systems.
   3. Duct detector flow confirmation.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

A. TAB procedures and qualifications.

B. Certified TAB reports.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

B. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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 systems for installed 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 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 test reports specified in individual system and equipment Sections.

F. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

G. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

H. 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.

I. Ensure that filters are clean prior to starting TAB.

3.2 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".

B. On fans systems that have belt drives with no variable frequency drives, TAB contractor shall include sheave changes for 20% of the equipment on the project to facilitate proper airflow balancing.

C. In addition to standards above, balance supply, return, and exhaust grilles to plus/minus 10% of design values. For rooms with a positive or negative pressure relationship per design, TAB contractor shall insure that pressure relationship is maintained.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Flexible elastomeric for equipment.
      b. Mineral fiber.
   2. Adhesives.
   3. Sealants.
   4. Factory-applied jackets.
   5. Field-applied jackets.
   6. Tapes.
   7. Securements.

B. Related Sections:
   1. Division 22 Section "Plumbing Insulation."
   2. Division 07 Section “Insulative Fireproofing”

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 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. Flexible Elastomeric for equipment: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Duct Wrap.
   d. Owens Corning; All-Service Duct Wrap.

F. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000 Pipe Insulation.
   c. Manson Insulation Inc.; Alley-K.
   d. Owens Corning; Fiberglas Pipe 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.

2.2 ADHESIVES

G. 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.

H. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armaflex; 520 BLV Adhesive.
   b. Armaflex; Low VOC spray contact Adhesive

I. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-82.
   b. Foster Products Corporation, H. B. Fuller Company; 85-20.

J. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The); 739, Dow Silicone.
   b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   c. Speedline Corporation; Speedline Vinyl Adhesive.

2.3 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; CP-76-8.
      b. Foster Products Corporation, H. B. Fuller Company; 95-44.
      c. Marathon Industries, Inc.; 405.
   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
   5. Color: Aluminum.
   6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto PVC Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. 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.

C. Aluminum Jacket: Comply with ASTM B 209 Alloy 3003, 3005, 3105 or 5005, Temper H-14. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; Metal Jacketing Systems.
      b. PABCO Metals Corporation; Surefit.
      c. RPR Products, Inc; Insul-Mate.
   2. 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.

2.5 SECUREMENTS

A. Aluminum Bands: ASTM B 209 Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products; Bands.

b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

B. Insulation Pins, Hangers, staples and wires:
1) Provide necessary pins with adhesive, hangers, staples and wires to meet all requirements of the insulation manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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. 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.
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.

H. Apply adhesives and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

I. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

J. 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.

K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

3.3 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. 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.

B. Insulation Installation on chilled water pumps; Provide one of the following methods:
   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 8-inch centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.

3.4 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.
   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.
   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. 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.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION FOR PIPING

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. Painting of closed cell foam insulation shall not be accepted.

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.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   2. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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.

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.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins per manufacturer's recommendations.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch 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.

B. 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 aluminum bands 12 inches on center and at end joints.

3.8 FINISHES

A. Flexible Elastomeric Thermal Insulation where used outdoors: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Ducts Requiring Insulation:
1. Indoor, concealed.

B. Items Not Insulated:
1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Metal ductwork with duct liner of sufficient thickness to comply with Title-24.
4. Flexible connectors.
5. Vibration-control devices.
6. Access panels and doors.

3.10 DUCT INSULATION SCHEDULE

A. Insulate ductwork per Title-24 Requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Refrigerant piping = Thickness per Title-24 Requirements.
1. Flexible Elastomeric

B. Hot and Chilled water piping = Per Title-24 Requirements.
   1. Fiberglass molded pipe insulation with an all service jacket.

3.13 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. All exposed piping, (including areas without ceilings):
   1. PVC 20 mils thick.

3.14 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. All piping, Exposed:
   1. Aluminum 0.020” thick. Embossed finish.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for split system and variable refrigerant split system air-conditioning applications.

1.2 SUBMITTALS

A. Product Data:
   1. For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
   2. Piping and specialties.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.4 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ACR, Type L

B. Line Sets: ACR, Type L or K. UL listed to 700 PSI. R410A engineered and tested. Pre-insulated with minimum 1/2" insulation, meeting ASTM E-84

C. Wrought-Copper Fittings: ASME B16.22. All 90 degree elbows shall be long radius.

D. Brazing Filler Metals (Copper to Copper): 15% silfoss

E. Brazing Filler Metals (Copper to Brass): 45% silfloss.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. VRF Systems (between condensing unit and AHU): Hard piped copper tubing.

B. Stand-alone split Systems: Hard piped copper tubing.

3.2 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.

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. Select system components with pressure rating equal to or greater than system operating pressure.

I. Slope refrigerant piping per manufacturers guidelines.

J. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

K. Insulate refrigerant piping per 230700.

3.3 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BcuP, copper-phosphorus alloy (non-oxidizing) for joining copper socket fittings with copper pipe.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspect using manufacturer’s guidelines.

3.6 SYSTEM CHARGING

A. Charge system using manufacturer's guidelines.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.
8. Duct Pressure Testing.

B. Related Sections:
1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers, 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" and 2016 CBC.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

C. 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
   2. Size and location of initial access modules for acoustical tile.
   3. Penetrations of smoke barriers and fire-rated construction.
   4. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Sprinklers.
      d. Access panels.

D. Welding certificates.

PART 2 - PRODUCTS

2.1 RECTANGULAR 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. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Transverse (Girth) Joints," 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."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Longitudinal Seams - Rectangular Ducts," 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."

D. 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."

2.2 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Transverse Joints - Round Duct," 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."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Seams - Round Duct and Fittings," 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."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," 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."

2.3 SHEET METAL 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.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Tie Rods: Comply with SMACNA HVAC duct construction standards.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Johns Manville.
   b. Knauf Insulation.

c. Owens Corning.

2. Maximum Thermal Conductivity:

a. Type I, Flexible: “R” value of 4.2 per inch minimum at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

B. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

2.5 SEALANT

A. General Sealant 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; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 66 percent.
3. Water resistant.
4. Mold and mildew resistant.
5. VOC: Maximum 75 g/L (less water).
6. Minimum Static-Pressure Rating: 10-inch wg, positive.
7. Service: Indoor.

2.6 TAPES

A. Sealing of manufacturer specific rectangular joints (TDC, etc), shall utilize “Ductmate” #440 butyl gasket or equal.

2.7 HANGERS AND SUPPORTS

A. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

PART 3 - EXECUTION

3.1 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 factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

D. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

G. 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.

H. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces 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. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal all ducts regardless of pressure classification.

3.4 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.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install drilled in anchors after concrete has been poured.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing.

D. Hangers Exposed to View: Threaded rod and angle or channel supports. Pre-manufactured hanger systems by Gripple or equal are also acceptable.

E. 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.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by 2019 CBC.

B. 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.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:
   1. Up stream of VAV boxes = 4” positive.

2. Downstream of VAV boxes = 2” positive.

C. General Return and Exhaust Ducts:
   1. All return and exhaust = 2” negative.

D. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      b. 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."
   2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
      a. 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.
         1) Radius-to Diameter Ratio: 1.5.

E. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Conical spin in fitting, 45 deg shoe tap, 45 deg lateral tap.
   2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees."
      a. All velocities: 45 deg lateral fitting, conical tap, 45 deg shoe tap.

F. Duct Pressure Testing:
   1. Test all ductwork as noted below per CMC 603.10.1 and SMACNA “HVAC Air Duct Leakage Test Manual”. The following Leakage Factors shall be utilized:
      a. 4” Duct Pressure – Round Ductwork = 0.07, Rectangular = 0.15.
   2. Test the following ductwork:
      a. All supply air ducts upstream of VAV boxes (unless exposed).
   3. The following ductwork does not require duct pressure testing:
      a. Exhaust ductwork.
      b. Supply ductwork downstream of CAV’s.
      c. Return ductwork.
      d. Exposed ductwork.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backdraft dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire Smoke dampers.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Flexible ducts.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

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 and smoke-damper installations, including sleeves; and duct-mounted access doors.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

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."

PART 2 - PRODUCTS

2.1 MATERIALS

A. 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.

2.2 BACKDRAFT DAMPERS

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. Air Balance Inc.
   2. Cesco Products
   3. Pottorff; a division of PCI Industries, Inc.
   4. Ruskin Company.
   5. Greenheck
   6. SEMCO Incorporated.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1500 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: 0.052-inch thick, galvanized sheet steel, with welded corners.

F. Blades: Multiple single-piece blades, center-pivoted maximum 6-inch width, 0.025” inch thick, with sealed edges.

G. Blade Action: Parallel.

H. Blade Axles:
   1. Material: Galvanized steel.
   2. Diameter: 0.20 inch.

I. Accessories:
   1. Counterweights and spring-assist kits for vertical airflow installations.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   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. Ruskin Company
      b. McGill AirFlow LLC.
      c. METALAIRE, Inc.
      d. Young Regulator Company
   2. Suitable for horizontal or vertical applications.
   3. Rectangular volume damper 12” high and less:
      a. Single Blade: 18 gauge, with stiffeners as required per SMACNA.
      b. Rod: 3/8” square rod 18” wide and less. ½” rod 19” wide and above.
      c. Blade Clip: Ventock #618. Spot welded to damper blade up to 18” wide and “U-bolt” or welded for 19” and above.
      d. Bearings: Nylon, with stand off bracket at handle.

e. Quardrant: Ventlok #638 for damper width up to 18” and Ventlok #555 for 19” and above.

4. Rectangular volume damper over 12” high:
   a. 16 gage galvanized steel hat channel frame.
   b. Multiple Blades: 14 gage, 6” wide airfoil blades with edge seals.
   c. Rod: ½” diameter round rod.
   d. Bearings: Stainless steel sleeve.
   e. Quardrant: Ventlok #638 for damper width up to 18”and Ventlok #555 for 19” and above.
5. Round volume damper:
   a. Single Blade: 18 gage, with stiffeners as required per SMACNA.
   b. Rod: 3/8” square rod 18” diameter and less. ½” square rod 19” diameter and above.
   c. Blade Clip: Ventock #618. Spot welded to damper blade up to 18” wide and “U-bolt” or welded for 19” and above.
   d. Bearings: Nylon, with stand off bracket at handle.
   e. Quardrant: Ventlok #638 for damper width up to 18” and Ventlok #555 for 19” and above.
6. Concealed ceiling control:
   a. Rack and pinion controller: 14 gage galvanized steel capable of up to 35 inch pounds of push pull torque.
   b. Inner wire: 0.054” type 302 stainless steel control wire encapsulated in 1/16” flexible galvanized spiral wire sheath not to exceed 50 feet long. Tensile strength of 265,000 pounds.
   c. Ceiling cover plate: 3” diameter zinc plated steel cover plate.

2.4 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cesco Products; a division of Mestek, Inc.
   2. Duro Dyne Inc.
   3. METALAIRE, Inc.
   4. Ruskin Company – CD60
   5. Vent Products Company, Inc.

B. Rectangular control dampers:
   a. 16 gage galvanized steel hat channel frame.
   b. Multiple Blades: 14 gage, 6” wide airfoil blades with edge seals.
   c. Rod: ½” or 1” diameter round rod (size depending).
   d. Bearings: Stainless steel sleeve.

2.5 TURNING VANES

A. Manufacturers: Subject to compliance requirements, [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:
   1. Ductmate Industries, Inc.

2. Duro Dyne Inc.

B. 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.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: 2” Double wall for ducts up to 12” wide. 4” vanes for ducts 13” wide and larger.

2.6 DUCT-MOUNTED ACCESS DOORS

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. Cesco Products; a division of Mestek, Inc.
2. Ductmate Industries, Inc.
3. McGill AirFlow LLC.
4. Nailor Industries Inc.

B. Duct-Mounted Access Doors:
1. Door:
a. Two piece “sandwich” access door.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Fabricate doors airtight and suitable for duct pressure class.

2.7 FLEXIBLE CONNECTORS

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. Ductmate Industries, Inc.
2. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics, meeting the 25/50 flame/smoke requirement.

C. 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 20 to plus 200 deg F.

D. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd.

2. Minimum Tensile Strength: 500 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 10 to plus 250 deg F.

2.8 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Flexmaster U.S.A., Inc. – Type 8M
2. Thermaflex – M-KE
3. Flexmaster U.S.A., Inc. – Type 6
4. Flexmaster U.S.A., Inc. – Type M-KE

B. Insulated, Acoustical Rated Flexible Duct: UL 181, Class 1, CPE liner duct permanently bonded to a coated spring steel wire helix and supporting a fiberglass insulating blanket. Encapsulated with a low permeability outer vapor barrier of reinforced metalized aluminum fiberglass.
1. Pressure Rating: 8-inch wg positive and 1 inch wg negative (4-12 inch diameter).
2. Maximum Air Velocity: 5000 fpm.
3. Insulation R-value: R 4.2 (min).

C. Flexible Duct Connectors:
1. Clamps: Nylon straps complying with UL-181B in sizes 3 through 18 inches to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. 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.
1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated. Provide plugs as required.

F. Install fire and smoke dampers according to UL listing.

G. Install duct access doors on sides of ducts to allow for inspecting, cleaning, adjusting, and maintaining accessories and equipment at the following locations:
   1. At drain pans and seals.
   2. Adjacent to and close enough to fire or smoke dampers.
   3. Control devices requiring inspection.

H. Access Door Sizes:
   1. One-Hand or Inspection Access: Minimum 8 by 4 inches.
   2. Two-Hand Access: Minimum 12 by 8 inches.
   3. Head and Hand Access: Minimum 18 by 14 inches.

I. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

J. Install flexible connectors to connect ducts to equipment.

K. Install duct test holes where required for testing and balancing purposes. Plug upon completion of TAB.

3.2 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 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.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

A. Furnish and install a digital Building Automation System (BAS) as specified herein.

B. Coordination with other Divisions: See coordination matrix in Section 230501 Basic Mechanical Materials and Methods.

1.2 CONTRACTOR PROPOSALS

A. The system requirements described in this specification are generally performance based. Where requirements are prescriptive, the intent is to provide minimum quality, not to give unfair advantage to any given manufacturer or product. If a contractor finds that a certain requirement is unduly difficult or expensive to meet, contact the Engineer prior to bid due date and an addendum modifying the requirement will be considered.

B. Where requirements are unclear, the contractor shall clarify the requirements with the Engineer before the bid due date. Where requirements continue to be unclear, the contractor's proposal must accurately describe what is included and excluded.

C. By submitting a proposal, contractor guarantees that their proposal is in full compliance with these specifications except as specifically excluded in their proposal.

1.3 REFERENCE STANDARDS

A. Nothing in Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, and regulations. When Contract Documents differ from requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement.

B. The latest published or effective editions, including approved addenda or amendments, of the following codes and standard shall apply to the BAS design and installation as applicable.

C. State, Local, and City Codes

1. CBC − California Building Code

2. CMC − California Mechanical Code

3. CEC – California Electrical Code

4. Local City and County Codes

D. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

1. ANSI/ASHRAE 135 – BACnet - A Data Communication Protocol for Building Automation and Control Networks

2. ANSI/ASHRAE Standard 135.1− Method of Test for Conformance to BACnet

3. ANSI/ASHRAE Standard 15 – Safety Standard for Refrigeration Systems

E. Electronics Industries Alliance

1. EIA-232 – Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

2. EIA-458 – Standard Optical Fiber Material Classes and Preferred Sizes.

3. EIA-485 – Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.

4. EIA-472 – General and Sectional Specifications for Fiber Optic Cable.

5. EIA-475 – Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications.

6. EIA-573 – Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications.

7. EIA-590 – Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications.

F. Underwriters Laboratories

1. UL 916 – Energy Management Systems.

G. National Electrical Manufacturers Association

1. NEMA 250 – Enclosure for Electrical Equipment.

H. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems.

2. IEEE 802.3 – CSMA/CD (Ethernet – Based) LAN.

1.4 DEFINITIONS

A. Acronyms

AAC	Advanced Application Controller
AH	Air Handler
AHU	Air Handling Unit
AI	Analog Input
ANSI	American National Standards Institute
AO	Analog Output
ASC	Application Specific Controllers
ASCII	American Standard Code for Information Interchange
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
A-to-D	Analog-to-Digital
BACnet	Data Communications Protocol for Building Automation and Control Systems
BC	Building Controller
BIBB	BACnet Interoperability Building Blocks
BTL	BACnet Testing Laboratory
CAD	Computer Aided Drafting
CHW	Chilled Water
CHWR	Chilled Water Return
CHWS	Chilled Water Supply
COV	Change of Value
CSS	Control Systems Server
CU	Controller or Control Unit
CV	Constant Volume
CW	Condenser Water
CWR	Condenser Water Return
CWS	Condenser Water Supply
DBMS	Database Management System
DDC	Direct Digital Control
DHW	Domestic Hot Water
DI	Digital Input
DO	Digital Output
D-to-A	Digital-to-Analog
BAS	Building Automation System
EMT	Electrical Metallic Tubing
EP	Electro-Pneumatic
ETL	Edison Testing Laboratories
GUI	Graphical User Interface
HHD	Hand Held Device
HOA	Hand-Off-Automatic
HVAC	Heating, Ventilating and Air-Conditioning
HTTP	Hyper-Text Transfer Protocol

I/O	Input/output
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LAN	Local Area Network
LANID	LAN Interface Device
MAC	Medium Access Control
MHz	Megahertz
MS/TP	Master-Slave/Token-Passing
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
ODBC	Open Database Connectivity
OI	Operator Interface
OWS	Operator Workstation
P	Proportional
PC	Personal Computer
PI	Proportional-Integral
PICS	Protocol Implementation Conformance Statement
PID	Proportional-Integral-Derivative
POT	Portable Operators Terminal
PTP	Point-to-Point
RAM	Random Access Memory
SOO	Sequence of Operation
SQL	Standardized Query Language
SSL	Secure Socket Layers
TAB	Test, Adjust, and Balance
TDR	Time Delay Relay
UFT	Underfloor Fan Terminal Box
UL	Underwriters' Laboratories, Inc.
XML	Extensible Markup Language

B. Terms

Term	Definition
Accessible	Locations that can be reached with no more than a ladder to assist access and without having to remove permanent partitions or materials. Examples include inside mechanical rooms, mechanical equipment enclosures, instrument panels, and above suspended ceilings with removable tiles.
BACnet Interoperability Building Blocks	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device in a specification.

Term	Definition
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
Change of Value	An event that occurs when a digital point changes value or an analog value changes by a predefined amount.
Client	A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
Concealed	Embedded in masonry or other construction, installed in furred spaces, within double partitions, above hung ceilings, in trenches, in crawl spaces, or in enclosures.
Continuous Monitoring	A sampling and recording of a variable based on time or change of state (such as trending an analog value, monitoring a binary change of state).
Contract Documents	Specifications, drawings, and other materials provided with request for bids.
Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.
Controller	Intelligent stand-alone control device. Controller is a generic reference to BCs, AACs, and ASCs.
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Building Automation System	The entire integrated building management and control system.
Equal	Approximately equal in material types, weight, size, design, quality, and efficiency of specified product.
Exposed	Not installed underground or concealed.
Furnish	To purchase, procure, acquire and deliver complete with related accessories.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Hand Held Device	Manufacturer’s microprocessor based portable device for direct connection to a field Controller.
Inaccessible	Locations that do not meet the definition of accessible. Examples include inside furred walls, pipe chases and shafts, or above ceilings without removable tiles.
Indicated, shown or noted	As indicated, shown or noted on drawings or specifications.
Install	To erect, mount and connect complete with related accessories.

Term	Definition
Instrumentation	Gauges, thermometers and other devices mounted in ductwork or piping that are not a part of the BAS.
College IT LAN	The Information Technology local area network furnished by the College or Division 27 Communications, used for normal business-related communication and may be used for interconnecting some BAS controllers and gateways where specified.
LAN Interface Device	Device or function used to facilitate communication and sharing of data throughout the BAS.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Passing	Data link protocol as defined by the BACnet standard.
Motor Controllers	Starters, variable speed drives, and other devices controlling the operation of motors.
Native BACnet Device	A device that uses BACnet for communication. A device may also provide gateway functionality and still be described as a Native BACnet device.
Native BACnet System	A network composed only of Native BACnet Devices without gateways.
Open Database Connectivity	An open standard application-programming interface for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system is handling the data.
Open Connectivity	OPC is an interoperability standard developed for industrial applications. OPC compliant systems make it possible to access or exchange data from any application, regardless of which database management system is handling the data.
Operator Interface	A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.
Operator Workstation	The user's interface with the BAS system. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.
College	The College or their designated representatives.
Piping	Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and related items.
Points	All physical I/O points, virtual points, and all application program parameters.

Term	Definition
Point-to-Point	Serial communication as defined in the BACnet standard.
Portable Operators Terminal	Laptop PC used both for direct connection to a controller and for remote dial up connection.
Primary LAN	High speed, peer-to-peer controller LAN connecting BCs, AACs, and ASCs as well as some gateways. See System Architecture below.
Protocol Implementation Conformance Statement	A written document that identifies the particular options specified by BACnet that are implemented in a device.
Provide	Furnish, supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted.
Protocol Translator	A device that converts BACnet from one network protocol to another.
Reviewed, approved, or directed	Reviewed, approved, or directed by or to College's Representative.
Router	A device that connects two or more networks at the network layer.
Secondary LAN	LAN connecting some gateways and networked sensors. See System Architecture below.
Server	A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.
Standardized Query Language	SQL - A standardized means for requesting information from a database.
Supervisory LAN	Ethernet-based LAN connecting Primary LANs with each other and OWSs, CSS, and THS. See System Architecture below.
Supply	Purchase, procure, acquire and deliver complete with related accessories.
Wiring	Raceway, fittings, wire, boxes and related items.
Work	Labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.

1.5 QUALITY ASSURANCE

A. Materials and Equipment

1. Manufacturer's Qualifications: See 2.1 for approved manufacturers.

B. Installer

1. BAS Contractor's Project Manager Qualifications: Individual shall specialize in and be experienced with direct digital control system installation for not less than 3 years. Project Manager shall have experience with the installation of the proposed direct digital control equipment product line for not less than 2 projects of similar size and complexity. Project Manager must have proof of having successfully completed the most advanced training offered by the manufacturer of the proposed product line.

2. BAS Contractor's Programmer Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system programming for not less than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Programmers must show proof of having successfully completed the most advanced programming training offered by the vendor of the programming application on the proposed product line.

3. BAS Contractor's Lead Installation Technician Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system installation for not less than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Installers must show proof of having successfully completed the installation certification training offered by the vendor of the proposed product line.

4. BAS Contractor's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. BAS Contractor must document a minimum 5-year history of servicing installations of similar size and complexity. Installer must also document at least a 1-year history of servicing the proposed product line.

5. Installer's Response Time and Proximity

   a. Installer must maintain a fully capable service facility within 50 miles of the subject Project. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.

   b. Installer must demonstrate the ability to meet the emergency response times listed in Paragraph 1.11B.1.

6. Electrical installation shall be by manufacturer-trained electricians

   a. Exception: Roughing in wiring and conduit and mounting panels may be subcontracted to any licensed electrician.

1.6 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 College's Representative.

B. Submit drawings and product data as hereinafter specified. Conditions in this Section take precedence over conditions in Division 1 or Section 230501 Basic Mechanical Materials and Methods.

C. Submittal Schedule: Submittal schedule shall be as follows unless otherwise directed by the College's Representative:

1. Allow 10 working days for approval, unless College's Representative agrees to accelerated schedule.

2. Submittal Package 0 (Qualifications) shall be submitted with bid.

3. Submittal Package 1 (Hardware and Shop Drawings) shall be submitted in accordance with schedule established by the College in bid documents.

4. Submittal Package 2 (Programming and Graphics) and shall be submitted no less than 30 days before software is to be installed in field devices.

5. Submittal Package 3 (Pre-Functional Test Forms) shall be submitted no less than 30 days prior to conducting tests.

6. Submittal Package 4 (Pre-Functional Test Report) shall be submitted no less than 14 after conducting tests.

7. Submittal Package 5 (Post-Construction Trend Points List) shall be submitted 14 days prior to the start of the trend collection period.

8. Submittal Package 6 (Functional Test Report) shall be submitted no more than 7 days after conducting tests.

9. Submittal Package 7 (Training Materials) shall be submitted no less than 14 days prior to conducting first training class.

10. Submittal Package 8 (Post-Construction Trend Logs) shall be submitted after demonstration tests are accepted and systems are in full automatic operation.

D. Submission and Resubmission Procedure

1. Optional Pre-Submittals. At Contractor's option, electronic submittals indicated below may be submitted unofficially via email directly to the Engineer 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.

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 250000-01.

3. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 250000-01 REVISION 1.

4. Submit one copy of submittal in electronic format specified under each submittal package below. Submissions made in the wrong format will be returned without action.

5. Submittals shall have bookmarks for each subsection (e.g. Materials, Drawings) and for each drawing including drawing number and name.

6. College's Representative will return a memo or mark-up of submittal with comments and corrections noted where required.

7. Make corrections

   a. Revise initial submittal to resolve review comments and corrections.

   b. Clearly identify resubmittal by original submittal number and revision number.

   c. The cover page of resubmittals shall include a summary of prior comments and how they were resolved in the resubmittal.

   d. Indicate any changes that have been made other than those requested.

8. Resubmit revised submittals until no exceptions are taken.

   a. The cost of Taylor Engineering's review of submittals after first resubmittal will be borne by Contractor at Taylor Engineering standard billing rates.

9. Once submittals are accepted with no exceptions taken, provide

   a. Complete submittal of all accepted drawings and products in a single electronic file.

   b. Photocopies or electronic copies for coordination with other trades, if and as required by the General Contractor or College's Representative.

E. Submittals Packages

1. Submittal Package 0 (Qualifications)

   a. Provide Installer and Key personnel qualifications as specified in Paragraph 1.5B.

   b. Format: Word-searchable format per Paragraph 1.7C.3.

2. Submittal Package 1 (Hardware and Shop Drawings)

    a. Hardware

        1) Organize by specification section and device tags as tagged in these specifications.

        2) Do not submit products that are not used even if included in specifications.

        3) Include a summary table of contents listing for every submitted device:

            a) Tab of submittal file/binder where submittal is located

            b) Device tag as tagged in these specifications (such as TS-1A, FM-1)

            c) Specification section number (down to the lowest applicable heading number)

            d) Whether device is per specifications and a listed product or a substitution

            e) Manufacturer

            f) Model number

            g) Device accuracy (where applicable)

            h) Accuracy as installed including wiring and A/D conversion effects (where applicable)

        4) Submittal shall include manufacturer's description and technical data, such as performance data and accuracy, product specification sheets, and installation instructions for all control devices and software.

        5) 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. Each submitted piece of literature and drawings shall clearly reference the specification or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.

        6) A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface.

        7) Format: Word-searchable format per Paragraph 1.7C.3.

    b. Shop Drawings

1) System architecture one-line diagram indicating schematic location of all control units, workstations, LAN interface devices, gateways, etc. Indicate address and type for each control unit. Indicate media, protocol, baud rate, and type of each LAN.

2) Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. The schematics provided on Drawings shall be the basis of the schematics with respect to layout and location of control points.

3) 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.

4) Label each input and output with the appropriate range.

5) Device table (Bill of Materials). With each schematic, provide a table of all materials and equipment including:

   a) Device tag as indicated in the schematic and actual field labeling (use tag as indicated in these specifications where applicable and practical)

   b) Device tag as indicated in these specifications where applicable and if it differs from schematic device tag

   c) Description

   d) Proposed manufacturer and model number

   e) Range

   f) Quantity

6) With each schematic or on separate valve sheet, provide valve and actuator information including pipe size, valve size, C_v, design flow, target pressure drop, actual design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of fail-safe valves and dampers.

7) Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

8) Details of control panels, including controllers, instruments, and labeling shown in plan or elevation indicating the installed locations.

9) Floor plans: None required.

10) Format

a) Sheets shall be consecutively numbered.

b) Each sheet shall have a title indicating the type of information included and the mechanical/electrical system controlled.

c) Table of Contents listing sheet titles and sheet numbers.

d) Legend and list of abbreviations.

e) Schematics

1. Word searchable pdf format.

2. 21 inch x 15 inch or 17 inch x 11 inch.

f) Floor plans: None required

1. AutoCAD compatible format

2. 21 inch x 15 inch or 17 inch x 11 inch

c. Do not include sequence of controls on shop drawings or equipment submittals; they are included in Submittal Package 2.

3. Submittal Package 2 (Programming and Graphics)

a. A detailed description of point naming convention conforming to Paragraph 3.13B to be used for all software and hardware points, integrated with existing database convention.

b. A list of all hardware and software points identifying their full text names, device addresses and descriptions.

c. Control Logic Documentation

1) Submit control logic program listings (graphical programming) consistent with specified English-language Sequences of Operation for all control units.

2) Control logic shall be annotated to describe how it accomplishes the sequence of operation. 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.

3) Include a MS Word file of the specified English-language Sequences of Operation of each control sequence updated to reflect any suggested changes made by the Contractor to clarify or improve the sequences. Changes shall be clearly marked. Also merge Guideline 36 sequences, where referenced, verbatim into the file; see Section 259000 Building Automation Sequences of Operation. SOOs shall be fully consistent with the graphical programming.

4) Include control settings, setpoints, throttling ranges, reset schedules, adjustable parameters and limits.

5) Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation.

d. Graphic screens of all required graphics, provided in final colors.

e. Format

1) Points list: Word-searchable format per Paragraph 1.7C.3.

2) Programming: Native electronic file if interpreter is available (such as ALC Eikon or Alerton Visio); otherwise provide pdf files of screen shots.

3) Control sequences: MS Word

4) Programming and operating manual: Word-searchable format per Paragraph 1.7C.3.

5) Graphics: Graphical electronic format (pdf, png, etc.).

4. Submittal Package 3 (Pre-Functional Test Forms)

a. Provide pre-functional test forms as required by Paragraph 3.15D.23.15D.2.a.

b. Format: Word-searchable format per Paragraph 1.7C.3.

5. Submittal Package 4 (Pre-Functional Test Report)

a. Provide Pre-Functional Test Report as required by Paragraph 3.15D.2.

b. Format: Word-searchable format per Paragraph 1.7C.3.

6. Submittal Package 5 (Post-Construction Trend Points List)

a. Provide a list of points being trended along with trend interval or change-of-value per Paragraph 3.15H.2.d.

b. Format: Word-searchable format per Paragraph 1.7C.3.

7. Submittal Package 6 (Functional Test Report)

a. Provide completed functional test forms as required by Paragraph 3.15F.4.

b. Format: Word-searchable format per Paragraph 1.7C.3.

8. Submittal Package 7 (Training Materials)

a. Provide training materials as required by Paragraph 3.16.

b. Format: Word-searchable format per Paragraph 1.7C.3.

9. Submittal Package 8 (Post-Construction Trend Logs)

a. Provide trend logs as required by Paragraph 3.15H.

b. Format: Word-searchable format per Paragraph 1.7C.3.

1.7 COMPLETION REQUIREMENTS

A. Procedure

1. Until the documents required in this Section are submitted and approved, the system will not be considered accepted and final payment to Contractor will not be made.

2. Before requesting acceptance of Work, submit one set of completion documents for review and approval of College.

3. After review, furnish quantity of sets indicated below to College.

B. Completion Documents

1. Operation and Maintenance (O & M) Manuals. Provide in both paper and electronic format per Paragraph 1.7C.

a. Include the as-built version of all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual. Submittal data shall be located in tabs along with associated maintenance information.

b. Engineering, Installation, and Maintenance Manual(s) that explain how to design and install new points, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.

c. Complete original issue documentation, installation, and maintenance information for all third-party hardware and software provided, including computer equipment and sensors.

d. A list of recommended spare parts with part numbers and suppliers.

e. Operators Manual with procedures for operating the control systems, including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.

f. Programming Manuals with a description of the programming language, control block descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the programming editor.

g. Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

h. A listing and documentation of all custom software for the Project created using the programming language, including the set points, tuning parameters, and point and object database.

i. English language control sequences updated to reflect final programming installed in the BAS at the time of system acceptance. See Section 259000 Building Automation Sequences of Operation.

2. Complete original issue electronic copy for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

3. Complete electronic copy of BAS database, user screens, setpoints and all configuration settings necessary to allow re-installation of system after crash or replacement of server, and resume operations with the BAS in the same configuration as during College sign-off.

4. Project Record Drawings

   a. As-built versions of the submittal drawings in reproducible paper and electronic format per Paragraph 1.7C.

   b. As-built network architecture drawings showing all BACnet nodes including a description field with specific controller and device identification, description and location information.

5. Commissioning Reports. Completed versions of all Pre-functional, Functional, and Demonstration Commissioning Test reports, calibration logs, etc., per Paragraph 3.15A.9.

6. Copy of inspection certificates provided by the local code authorities.

7. Written guarantee and warranty documents for all equipment and systems, including the start and end date for each.

8. Training materials as required by Paragraph 3.16E.

9. Contact information. Names, addresses, and 24-hour telephone numbers of contractors installing equipment, and the control systems and service representatives of each.

C. Format of Completion Documents

1. Provide the type and quantity of media listed in table below.

2. Project database, programming source files, and all other files required to modify, maintain, or enhance the installed system shall be provided in their source format and compiled format (where applicable).

3. Where electronic copies are specified, comply with the following:

   a. Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf), and HTML; submit other formats for review and approval prior to submission; scanned paper documents not acceptable.

   b. For submittals, provide separate file for each type of equipment.

   c. Control sequences shall be in MS Word.

	Document	Paper (binder or bound)	Electronic	
			Loaded onto Flash Drive	Loaded onto CSS
1.	O&M Manual	2	1	1
2.	Original issue software	–	1 per workstation	1
3.	Project database including all source files	–	1 per workstation	1
4.	Project Record Drawings	2	1	1
5.	Control sequences	1	1	1
6.	Commissioning Reports	2	1	1
7.	Inspection Certificates	1	–	–
8.	Warranty documents	1	–	–
9.	Training materials	1 per trainee	1	1
10.	Contact information	1	–	1

D. Permanent On-site Documentation

1. In each panel, provide the following stored in clear plastic sleeve taped to the back of the panel door:

   a. 8.5x11 printout of as-built points list

b. 21 inch x 15 inch or 17 inch x 11 inch set of as-built shop drawings for devices in panel

1.8 BAS DESIGN

A. System Architecture

1. General

a. The system provided shall incorporate hardware resources sufficient to meet the functional requirements specified in this Section. Include all items not specifically itemized in this Section that are necessary to implement, maintain, and operate the system in compliance with the functional intent of this Section.

b. The system shall be configured as a distributed processing network(s) capable of expansion as specified herein.

c. The system will consist of BAS CSS located in the Building Engineer's Office. It will connect via a high-speed network to BCs and other control devices located throughout the building as well as the College IT LAN.

d. The BAS shall be standalone and not rely on any 3rd party networks, such as the College IT LAN, except as specifically allowed herein.

e. All control products provided for this Project shall comprise an interoperable Native BACnet System. All control products provided for this Project shall conform to ANSI/ASHRAE Standard 135.

f. Power-line carrier systems are not acceptable for BAS communications.

2. BAS Network Architecture

a. College IT LAN. Ethernet-based, 100 or 1000 Mbps BACnet/IP network specified under Division 27 Communications.

b. Supervisory LAN: The LAN shall be an Ethernet-based, 100 or 1000 Mbps network interconnecting the server and OWS(s) to BCs and certain gateways as specified herein. LAN shall be IEEE 802.3 Ethernet with switches and routers that support 100 Mbps minimum throughput. This network shall be BACnet/IP as defined in the BACnet standard, and shall share a common network number for the Ethernet backbone, as defined in BACnet.

c. Primary LAN: High-speed, peer-to-peer communicating LAN used to connect AACs, ASCs, and certain gateways and sensors where specified herein. Acceptable technologies include and are limited to:

1) Ethernet (IEEE802.3) per the Supervisory LAN

d. Secondary LAN: Network used only to connect certain gateways and sensors where specified herein. It shall not be used to interconnect BCs, AACs, and ASCs. Network speed versus the number of devices on the LAN shall be dictated by the response time and trending requirements. Acceptable technologies include but are not limited to:

   1) BACnet over Master Slave/ Token Passing (MS/TP)

   2) Modbus over RS-485 or IP

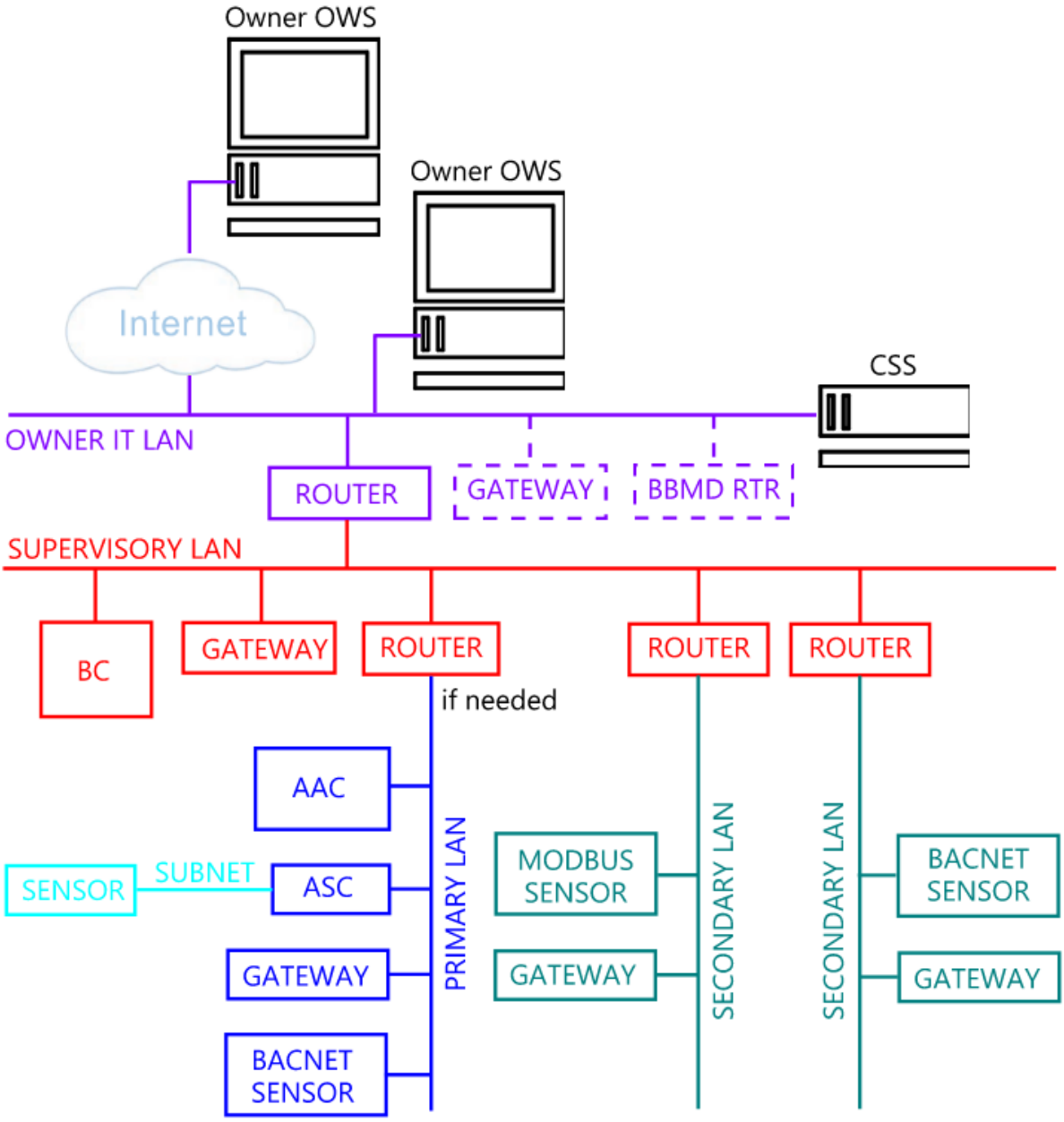
e. Subnets: Networks used to connect sensors and thermostats to AACs and ASCs. This network may as above for Secondary LANs or may be proprietary the manufacturer.

f. The figure below shows an example of the desired network architecture. Note:

   1) Not all devices shown will exist for this project.

   2) Ethernet network installer shall be responsible for assigning IP addresses to all devices on the network.

   3) If gateways are specified to be directly connected to the College IT LAN in Paragraph 2.4E, also provide and install a BBMD Router (both shown dashed in the schematic) including all configuration and programming.



1. Operator Interfaces and Servers

   a. Control Systems Server (CSS). This shall be a server upon which the systems configuration and programming databases are maintained and serves as web server for operator interface. It shall hold the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to or from the controllers. It shall also act as a control information server to non-control system based programs. It shall allow secure multiple-access to the control information. It shall also store trend data uploaded from controllers.

b. The Operator Interface shall provide for overall system supervision, graphical user interface, management report generation, alarm annunciation, and remote monitoring. The system shall be capable of supporting an unlimited number of clients using a standard Web browser.

c. Remote monitoring and control shall be through use of a web browser through the College IT LAN and via the internet through the College IT LAN.

2. Controllers. The BCs, AACs, and ASCs shall monitor, control, and provide the field interface for all points specified.

3. Gateways

a. See Paragraph 2.4E for a list of gateways and routers.

b. Where gateways are used, critical points shall be hardwired from the BAS to the controlled device, rather than using the gateway, to avoid problems with gateway failures, currently a common problem. Critical points are those that are essential for proper operation and are listed in points list as separate points. Where listed, these points shall be hardwired even when available through gateway.

B. System Performance

1. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. This includes when system is collecting trend data for commissioning and for long term monitoring. (See Paragraph 3.15H.) In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein, assuming no other simultaneous operator activity. Reconfigure LAN as necessary to accomplish these performance requirements. This does not apply to gateways and their interaction with non-BAS-vendor equipment.

a. Object Command: The maximum time between an operator command via the operator interface to change an analog or binary point and the subsequent change in the controller shall be less than 5 seconds.

b. Object Scan: All changes of state and change of analog values will be transmitted over the network such that any data used or displayed at a controller or workstation will have been current within the previous 10 seconds.

c. Graphics Scan: The maximum time between an operator’s selection of a graphic and it completely painting the screen and updating at least 10 points shall be less than 10 seconds.

d. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation or broadcast (where so

programmed) shall not exceed 10 seconds for a Level 1 alarm, 20 seconds for alarm levels 2 and 3, and 30 seconds for alarm levels 4 and 5. All workstations on the onsite network must receive alarms within 5 seconds of each other.

e. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.

f. 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 same frequency.

2. Sensor selection, wiring method, use of transmitters, A-to-D conversion bits, etc. shall be selected and adjusted to provide end-to-end (fluid to display) accuracy at or better than those listed in the following table.

Measured Variable	**Reported Accuracy**
Space drybulb temperature	±1ºF
Ducted Air drybulb temperature	±0.5ºF
Mixed Air drybulb temperature	±1ºF
Outside Air drybulb temperature	±0.5ºF
Chilled and Condenser Water Temperature	±0.2ºF
Hot Water Temperature	±0.5ºF
Relative Humidity − general	±5% RH
Relative Humidity − outdoor air	±3% RH
Water and Gas Flow	±1% of reading
Airflow (terminal)	±10% of reading
Airflow (measuring stations)	±5% of reading
Air Pressure (ducts)	±0.05 inches
Air Pressure (space)	±0.01 inches
Water Pressure	±2% of reading
Electrical power	1% of reading
Carbon Dioxide (CO_2)	±75 ppm

1.9 COLLEGESHIP OF PROPRIETARY MATERIAL

A. All project-developed software and documentation shall become the property of the College. 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 documentation

1.10 WARRANTY

A. At the successful completion of the final testing, commissioning, and demonstration phase in accordance with the terms of this specification, if equipment and systems are operating satisfactorily to the College and if all completion requirements per Paragraph 1.7B have been fulfilled, the College shall certify in writing that the control system has been accepted. The date of acceptance shall be the start of the warranty period.

B. Guarantee all materials, equipment, apparatus and workmanship (including programming) to be free of defective materials and faulty workmanship for the following periods from date of acceptance:

1. BCs, AACs, and ASCs: two years

2. Valve and damper actuators: five years

3. All else: one year

C. Provide new materials, equipment, apparatus and labor to replace that determined by College to be defective or faulty.

D. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the College. Contractor shall respond to the College's request for warranty service within 24 hours during normal business hours.

E. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies shall be provided at no cost to the College during the warranty period.

F. 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 College during this period.

1.11 WARRANTY MAINTENANCE

A. The College reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the College, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.

B. At no cost to the College, provide maintenance services for software and hardware components during the warranty period as specified below:

1. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the College to the Contractor.

    a. Response by telephone or via internet connection to the BAS to any request for service shall be provided within two hours of the College's initial request for service.

    b. In the event that the malfunction, failure, or defect is not corrected, at least one technician, trained in the system to be serviced, shall be dispatched to the College's site within eight hours of the College's initial request for such services.

2. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following notification by the College to the Contractor.

    a. Response by telephone to any request for service shall be provided within eight working hours (contractor specified 40 hr. per week normal working period) of the College's initial request for service.

    b. In the event that the malfunction, failure, or defect is not, at least one technician, trained in the system to be serviced, shall be dispatched to the College's site within three working days of the College's initial request for such services, as specified.

3. College's Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for College to call in the event of a need for service. At least one of the lines shall be attended continuously (24/7). Alternatively, pagers/SMS can be used for technicians trained in system to be serviced. One of the three paged/texted technicians shall respond to every call within 15 minutes.

4. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.

5. 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

2.1 PRIMARY BAS MANUFACTURER

A. Primary BAS manufacturers shall meet the following minimum qualifications:

1. The manufacturer agrees to fully program and test all ASHRAE Guideline 36 sequences that are referenced herein and in Section 259000 BAS Sequences of Operation for their dealers bidding this project at no direct cost to these dealers. The cost of Guideline 36 programming and testing shall not be a direct cost to this project.

2. The manufacturer has a minimum of three dealers who can bid on this project for this initial bid, all future improvements, and all future service work.

B. The following primary BAS manufacturers are known to meet the above criteria and are the basis of this specification:

1. Delta Controls (campus standard)

2.2 GENERAL

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way.

B. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

C. All controllers, associated hardware (repeaters, routers, etc.), sensors, and control devices shall be fully operational and maintain specified accuracy at the anticipated ambient conditions of the installed location as follows:

1. Outdoors or in harsh ambient conditions: -20°C to 55°C (-4°F to 130°F), 10% RH to 90% RH noncondensing.

2. Conditioned spaces or mechanical rooms: 0°C to 40°C (32°F to 104°F), 10% RH to 80% RH noncondensing.

2.3 CONTROLLERS

A. General

1. 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. The use of OWS or CSS to serve as a communications server between control panels and gateways is not acceptable.

2. For all controllers, operating configuration and software shall be retained in the event of a power outage without requiring a download from upper level controllers by one or a combination of the following:

a. Volatile RAM shall have a replaceable battery backup using a lithium battery with a rated service life of 10,000 hours continuous and a rated shelf life of at least 7 years.

b. Volatile RAM shall have a automatically rechargeable battery backup using a lithium battery with a rated service life of 50 hours continuous and a rated shelf life of at least 10 years.

c. EEPROM, EPROM, or NVROM non-volatile memory.

3. Controllers shall allow independent operation regardless of the status of the other controllers or OWS or CSS. BCs, AACs, and ASCs shall perform all specified control sequences independent of operator interface devices and servers, i.e. all programming shall reside in BCs, AACs, and ASCs.

4. Each controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall.

a. Assume a predetermined failure mode.

b. Generate an alarm notification to the master controller, Operator Workstation, or both.

5. All input points and output points shall be protected such that shorting of the point to itself — to another point, or to ground — will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

6. Programmability: All controllers, including BCs, AACs, and ASCs, shall be fully user programmable. Configurable pre-programmed logic shall not be acceptable in any controller. (This is required due to non-standard control sequences at AHUs and VAV terminal units.)

B. Stand-Alone Functionality

1. General: These requirements clarify the requirement for stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in Part 3. This item refers to acceptable paradigms for associating the points with the processor.

2. Functional Boundary: Provide controllers so that all points associated with and common to one unit or other complete system or equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the contract documents. Generally systems specified for the Application Category will dictate the boundary of the standalone control functionality. See related restrictions below. When referring to the controller with respect to standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.

3. The following configurations are considered acceptable with reference to a controller's standalone functionality:

    a. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).

    b. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.

    c. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.

4. The following configurations are considered unacceptable with reference to a controller's standalone functionality:

    a. Multiple controllers enclosed in the same control panel to accomplish the point requirement.

C. Building Controller (BC)

1. General Requirements

    a. BCs shall be peer-to-peer devices connected to the Primary Controller LAN.

    b. Each BC shall be capable of standalone direct digital operation utilizing its own microprocessor, internal RAM, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and surge protection devices, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure. Refer to standalone functionality specified above.

    c. The BC(s) shall provide fully distributed control independent of the operational status of the OWSs and CSS. All necessary calculations required to achieve control shall be executed within the BC independent of any other device.

    d. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACs/ASCs for full global control. Each controller shall permit multi-user operation from multiple workstations and portable operator terminals connected either locally or over the Primary Controller LAN.

    e. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.

f. The BC may provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Refer to standalone functionality specified above.

g. All BC point data, algorithms and application software shall be configurable, and all control strategies performed by the BC shall be both operator definable and modifiable, from Operator Interfaces. The point database and all application programs shall be stored in non-volatile or battery backed volatile memory within the BC and shall be able to upload to or download from the OWS or CSS.

h. BC shall provide buffer for holding alarms, messages, trends etc.

i. Each BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions or alarm conditions that exceed desired parameters as determined by programming input.

j. Each BC shall contain software to perform full DDC/PID control loops.

k. Memory

1) Memory for data trending shall reside in BCs; the Operator Workstation shall not need to be connected for data trending to occur. Memory shall be large enough to record 256 records of each hardware point on the panel and an equal number of software points, each record to include both data value and time of occurrence. See Paragraph 3.15H for trending software requirements.

2) Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of approximately 25% of available memory free for future programming changes.

3) Provide an additional BC if needed to comply with this Paragraph.

l. Input-Output Processing

1) Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 0.5 amp maximum current. Each shall be configurable as normally open or normally closed. Each DO shall be discrete outputs from the BC's board. Multiplexing to a separate manufacturer's board is unacceptable. Provide suppression to limit transients to acceptable levels.

2) Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, and 0-20 mA; or direct thermistor connection. Provide signal conditioning and zero and span calibration for each input. Each input shall be a discrete input to the BC's board. Multiplexing to a separate manufacturers board is unacceptable. A/D converters shall have a minimum resolution of 12 bits.

3) Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors is unacceptable.

4) Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.

5) Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog is not acceptable. D/A converters shall have a minimum resolution of 8 bits.

6) Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.

m. A communication port for operator interface through a terminal shall be provided in each BC. It shall be possible to perform all program and database back-up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected printers, or workstations.

n. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the Operator Workstation software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.

o. All output points shall have a selectable failure setpoint or mode. The BC shall be capable of maintaining this failure setpoint or mode in the event of a system malfunction, which causes loss of BC control or loss of output signal as long as power is available at the BC. The failure setpoint or mode shall be selectable on a per point basis.

p. Slope intercepts and gain adjustments shall be available on a per-point basis.

q. BC Power Loss

1) Upon a loss of power to any BC, the other units on the primary controlling network shall not in any way be affected.

2) Upon a loss of power, all software, database parameters, and data (except trend data) shall be protected from memory loss per Paragraph 2.3A.2.

3) Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time

dependent function is possible without manual reset of the clock. All monitored functions shall be updated.

4) Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report, or CSS shall automatically determine, the condition (upon resumption of power) and be capable of receiving a download via the network, and connected computer. In addition, the Owner shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the OWS via the local area network, or via the local RS-232C port to the POT.

r. BC Failure

1) Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value.

2) BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.

s. Each BC shall be equipped with firmware resident or software self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).

t. BCs may include LAN communications interface functions for controlling secondary LANs. Refer to Paragraph 2.3C for requirements if this function is packaged with the BC.

u. BCs shall be mounted on equipment, in packaged equipment enclosures, or locking wall mounted in a NEMA enclosure, as specified herein.

2. BACnet Building Controller Requirements

a. The BC(s) shall support all BIBBs defined in the BACnet Building Controller (B-BC) device profile as defined in the BACnet standard.

b. Each BC shall be connected to the BACnet Primary Controller LAN communicating to or from other BCs.

D. Advanced Application Controller (AAC) and Application Specific Controller (ASC)

1. General Requirements

a. AACs and ASCs shall be connected to the Primary or Secondary Controller LAN.

b. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the Secondary LAN. Refer to standalone requirements by application specified in Part 3 of this Section. In addition, it shall be able to share information with every other BC and AAC /ASC on the entire network.

c. Each AAC and ASC shall include self-test diagnostics that allow the AAC /ASC to automatically relay to the BC, LAN Interface Device or workstation, any malfunctions or abnormal conditions within the AAC /ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.

d. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.

e. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, voltage transient and surge protection devices to perform all specified application sequences.

f. All point data; algorithms and application software within an AAC /ASC shall be modifiable from Operator Interfaces.

g. Memory

    1) Memory for data trending is not required for AACs and ASCs. If not provided in controller, memory for trend data shall reside in BCs connected to the same Network.

    2) Provide sufficient internal memory for the specified sequences of operation. For AACs, there shall be a minimum of approximately 25% of available memory free for future programming changes. Provide additional AACs or a BC if needed to comply with this requirement.

h. AAC Input-Output Processing. Same as BCs (Paragraph 2.3C.1.l) except A/D converters may be 10 bit

i. ASC Input-Output Processing

    1) Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 0.5 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output. Each DO shall be discrete outputs from the

ASC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.

2) Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, 0-20 mA, or direct thermistor connection. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the ASC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 10 bits.

3) Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the ASC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of the Owner.

4) Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.

5) Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog is not acceptable. D/A converters shall have a minimum resolution of 8 bits.

2. BACnet AAC(s) and ASC(s) Requirements

a. The AAC(s) and ASC(s) shall support all BIBBs defined in the BACnet Building Controller (B-AAC and B-ASC) device profile as defined in the BACnet standard.

b. AAC(s) and ASC(s) shall communicate over the BACnet Primary Controller LAN or the Secondary LAN.

2.4 COMMUNICATION DEVICES

A. Controller Local Area Network Interface Devices (LANID)

1. The Controller LANID shall be a microprocessor-based communications device which acts as a gateway/router between the Primary LAN, Secondary LAN, an operator interface, or printer. These may be provided within a BC or as a separate device.

2. The LANID shall perform information translation between the Primary LAN and the Secondary LAN, supervise communications on a polling secondary LAN, and shall be applicable to systems in which the same functionality is not provided in the BC. In systems where the LANID is a separate device, it shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power

supply as specified for a BC in Paragraph 2.3C. Each LANID shall be mounted in a lockable enclosure.

3. Upon loss of power to a LANID, the battery shall provide for minimum 100-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

4. The LANID shall be transparent to control functions and shall not be required to control information routing on the Primary LAN.

B. Supervisory LAN Routers

1. The Supervisory Router shall be a microprocessor-based communications device that acts as a router between the Supervisory LAN CSSs or OWS and the Primary LAN.

2. The Supervisory Router shall not perform information translation. Both Primary LAN and the Supervisory LAN shall use BACnet.

3. The Supervisory Router shall contain its own microprocessor, RAM, communication ports, and power supply. Each Supervisory Router shall be mounted in a lockable enclosure.

4. The Supervisory Router shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, acquisition of trend data, and communication with control units. It shall allow system operators to perform the following functions from the CSS, OWSs, and POTs.

   a. Configure systems.

   b. Monitor and supervise control of all points.

   c. Change control setpoints.

   d. Override input values.

   e. Override output values.

   f. Enter programmed start/stop time schedules.

   g. View and acknowledge alarms and messages.

   h. Receive, store and display trend logs and management reports.

   i. Upload/Download programs, databases, etc. as specified.

5. Upon loss of power to the Supervisory Router, the battery shall provide for minimum 100-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

6. The Supervisory Router shall be transparent to control functions and shall not be required to control information routing on the Primary LAN.

C. BACnet broadcast message routing

1. To allow BACnet broadcast messages to be relayed from remote nodes communicating via the internet and connecting to the Supervisory Router through IP protocol, a BACnet/IP Broadcast Management Device (BBMD) shall be provided which conforms to the BACnet standard for two-hop distribution. Multicast messaging or one-hop distribution requiring configuration of IP routers which are not part of the BAS vendor's scope is not acceptable.

D. BACnet Gateways & Protocol Translators

1. Gateways shall be provided to link non-BACnet control products to the BACnet inter-network. All of the functionality described in this Paragraph is to be provided by using the BACnet capabilities. Each Gateway shall have the ability to expand the number of BACnet objects of each type supported by 20% to accommodate future system changes.

2. Each Gateway shall provide values for all points on the non-BACnet side of the Gateway to BACnet devices as if the values were originating from BACnet objects. The Gateway shall also provide a way for BACnet devices to modify (write) all points specified by the Points List using standard BACnet services.

3. Each Gateway shall provide a way to collect and archive or trend (time, value) data pairs.

4. Each Gateway and any devices that the Gateway represents which have time-of-day information shall respond to workstation requests to synchronize the date and time. Each Gateway and any devices that the Gateway represents shall support dynamic device binding and dynamic object binding.

5. All points in the system shall be made network visible through the use of standard BACnet objects or through proprietary BACnet extensions that the workstation also supports. All points shall be writable using standard BACnet services.

6. All devices have a Device Object instance number that is unique throughout the entire inter-network. All BACnet devices shall be configured with a Device Object instance number that is based on the format specified. This includes all physical devices as well as any logical BACnet devices that are physically represented by Gateways.

7. Upon loss of power to a Gateway, the battery shall provide for minimum 500-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

8. UL 916 CE FCC part 15 Subpart B – Class A with surge and transient protection circuitry for power and communications.

E. Gateways and Protocol Translators

Equipment/System	Interface			
	Type	Specified Under Division:	Location	Connect to this Network:
Variable Speed Drives	BACnet/MSTP	23	Each VFD	Secondary
Air-to-Water Heat Pumps	BACnet/IP	23	Each Heat Pump	Supervisory
Lighting Controls	BACnet/IP	26	Electrical Room	Supervisory
Power Monitoring	BACnet/IP	26	Electrical Room	Supervisory
Switchgear Digital Power Meters	BACnet/IP	26	Electrical Room	Supervisory
Emergency Generator	Modbus RS-485	26	Each generator	Secondary
DCW Booster pump	BACnet/MSTP	22	DCW Booster pump	Secondary

2.5 BAS INTERFACE HARDWARE

A. Control System Server (CSS)

1. Hardware:

a. Intel Core i5 Quad core 3.4 GHz (minimum) Processor

b. 8 GB DDR4 RAM (minimum)

c. 1 TB SATA hard drive with 6 GB/s transfer rate (minimum)

d. One Ethernet 10/100 Mbps internal network card (for connection to Supervisory LAN)

e. One Ethernet 10/100/1000 Mbps (1 Gbps) internal network card (for connection to College IT LAN)

f. 24 inch color, 1920 x 1200 pixel flat panel display.

g. 256 MB VGA/DVI graphics adapter

h. 2-button with scroll optical USB mouse

i. Enhanced USB 101-key keyboard

j. Internal speakers

k. High efficiency power supply; EnergyStar configured

l. One spare serial port and one spare USB port in addition to those needed for specified peripherals

m. 24x7 dedicated technical support service that delivers reduced hold time, direct access to advanced level technicians, and reduced time to resolution, minimum 3 years

n. Tower cabinet

2. Software by PC Supplier (factory installed):

a. Operating system: Microsoft Windows 10 Pro

b. Database: MySQL or MS SQL

c. Browser: Microsoft Internet Explorer, Firefox, or Chrome

d. All software shall be at least the latest version available as of the date of purchase.

B. Operator Workstation (OWS)

1. CSS doubles as OWS

C. Portable Operators Terminal (POT)

1. None required.

D. Uninterruptible Power Supply (UPS)

1. None required.

2.6 AIR TUBING

A. Seamless copper tubing, Type L-ACR, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder.

B. Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, and with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.

2.7 ELECTRIC WIRING AND DEVICES

A. All electrical work shall comply with Division 26.

B. Communication Wiring

1. Provide all communication wiring between Building Controllers, Protocol Translators, Gateways, AACs, ASCs and local and remote peripherals (such as operator workstations and printers).

2. Ethernet LAN: Use Fiber or Category 5e or 6 of standard TIA/EIA 68 (10baseT). Network shall be run with no splices and separate from any wiring over 30 volts.

3. RS-485 LAN: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over 30 volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.

C. Analog Signal Wiring

1. Input and output signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, current or voltage analog outputs, etc. shall be twisted pair, 100% shielded if recommended or required by controller manufacturer, with PVC cover. Gauge shall be as recommended by controller manufacturer.

2.8 CONTROL CABINETS

A. All control cabinets shall be fully enclosed with hinged door.

1. For panels in mechanical rooms and other spaces that are secure and accessible only to BAS/MEP operators, provide quarter-turn slotted latch.

2. For panels located in electrical rooms, IDF rooms, and other spaces that may be accessible by persons other than BAS/MEP operators, provide key-lock latch. A single key shall be common to all panels within each building. Provide 3 keys.

B. Construction

1. Indoor:

a. Mechanical or electrical rooms etc.: NEMA 1

b. Air plenums: NEMA 12

2. Outdoor: NEMA 4

C. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs or tie-wrapped. Terminals for field connections shall be UL Listed for service, individually identified per control-interlock drawings, with adequate clearance for field wiring. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.

Control terminations for field connection shall be individually identified per control Shop Drawings.

D. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

E. Provide with

1. Framed, plastic-encased point list for all points in cabinet.

2. Nameplates for all devices on face.

2.9 SENSORS AND MISCELLANEOUS FIELD DEVICES

A. The listing of several sensors or devices in this section does not imply that any may be used. Refer to points list in Paragraph 2.12 Points List for device specification. Only where two or more devices are specifically listed in points list (such as “FM-1 or FM-4”) may the Contractor choose among listed products.

B. Control Valves

1. Manufacturers

a. Belimo

b. Siemens

c. Schneider

d. Delta

e. JCI

f. Bray

g. Or equal

2. Butterfly Valves

a. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class bolt pattern to match specified flanges.

b. Seat: EPDM replaceable, non-collapsible, phenolic backed.

c. Disc: Polished aluminum bronze or stainless steel, pinned or mechanically locked to shaft. Sanded castings are not acceptable.

d. Bearings: Bronze or stainless steel.

e. Shaft: 416 stainless steel supported at three locations with PTFE bushings for positive shaft alignment.

f. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.

g. Manufacturers (In Addition to Paragraph 2.9B.1.)

1) Jamesbury

2) Keystone

3) Dezurik

4) Or equal

3. Two Position Ball Valves

a. Valves shall be specifically designed for two-position duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.

b. Industrial quality with nickel plated forged brass body and female NPT threads.

c. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 600 psi rating (1 inch and smaller) or 400 psi rating (larger than 1 inch). The stem packing shall consist of 2 lubricated O-rings designed for on-off service and requiring no maintenance.

d. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.

e. No characterization disks

f. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.

g. Ball: Chrome plated brass

h. Stem: Chrome plated brass

4. Modulating Characterized Ball Valves

a. Valves shall be specifically designed for modulating duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.

b. Industrial quality with nickel plated forged brass body and female NPT threads.

c. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 600 psi rating (2-way valves) or 400 psi rating (3-way valves). The stem packing shall consist of 2 lubricated O-rings designed for modulating service and requiring no maintenance.

d. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.

e. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.

f. Ball: stainless steel

g. Stem: stainless steel

h. Characterizing disk held securely by a keyed ring providing equal percentage characteristic

5. Minimum valve assembly pressure ratings

   a. Chilled water: 125 psi at 60ºF

   b. Hot water: 125 psi at 200ºF

   c. Condenser water: 125 psi at 100ºF

6. Valve Selection

   a. Valve type

      1) Modulating 2-way or 3-way valves

         a) 6 inch and less: characterized ball type

      2) Two-position isolation: butterfly or non-characterized ball type

   b. Valve Characteristic

      1) 2-way valves: equal percentage or modified equal percentage.

      2) 3-way valves controlling cooling coils and condenser water heat exchangers: linear.

      3) 3-way valves controlling heating coils: equal percentage or modified equal percentage.

      4) Two-position valves: not applicable. For ball valves used for two-position duty, do not include characterizing disk.

   c. Valve Sizing

1) Modulating Water: Size valve to achieve the following full-open pressure drop

a) Minimum pressure drop: equal to half the pressure drop of coil or exchanger.

b) Maximum pressure drop

1. Hot water at coils: 2 psi

2. Chilled water at coils: 5 psi

c) 3-way valves shall be selected for near minimum pressure drop. 2-way shall be selected near maximum pressure drop.

d) Flow coefficient (C_v) shall not be less than 1.0 (to avoid clogging)

e) Valve size shall match as close as possible the pipe size where C_v is available in that size.

2) Two-position valves: Line size unless otherwise indicated on Drawings.

C. Control Dampers

1. Section 237300 Air Handling Units & Coils

D. Actuators

1. Manufacturers

a. Belimo

b. No equal

2. Warranty: Valve and damper actuators shall carry a manufacturer's 5-year warranty.

3. Electric Actuators

a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.

b. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications.

c. Dampers. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The clamp shall be steel of a V-bolt design with associated V-shaped, toothed cradle attaching to the shaft for maximum strength and

eliminating slippage via cold weld attachment. Single bolt or set screw type fasteners are not acceptable. Aluminum clamps are unacceptable.

d. Valves. Actuators shall be specifically designed for integral mounting to valves without external couplings.

e. Actuator shall have microprocessor based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible.

f. Noise from actuator while it is moving shall be inaudible through a tee-bar ceiling.

g. Actuators shall provide protection against actuator burnout using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation or use of magnetic clutches are not acceptable.

h. Modulating Actuators. Actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. Actuators shall have positive positioning circuit so that controlled device is at same position for a given signal regardless of operating differential pressure. Actuators that internally use a floating actuator with an analog signal converter are not acceptable.

i. Where indicated on Drawings or Points List, actuators shall include

   1) 2 to 10 VDC position feedback signal

   2) Limit (end) position switches

j. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.

k. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.

l. Actuators shall be provided with a conduit fitting an a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

m. Where fail-open or fail-closed (fail-safe) position is required by Paragraph 2.9D.5, an internal mechanical, spring return mechanism shall be built into the actuator housing. Electrical capacitor type fail-safe are also acceptable. All fail-safe actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation. Spring

return 2-position fail-safe valves shall not be used in noise sensitive locations; use either electronic fail-safe where available, or use floating point type actuator with drive-open and drive-close wiring for normal open/close operation (spring shall only be used to cause valve to drive to fail-safe position upon a loss of power).

n. Actuators shall be capable of being mechanically and electrically paralleled to increase torque where required.

o. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 inch-pound torque capacity shall have a manual crank for this purpose.

p. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.

q. Actuators shall provide clear visual indication of damper/valve position.

4. Electric Actuators for Large Butterfly Valves

a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.

b. The valve actuator shall consist of a capacitor-type reversible electric motor, gear train, limit switches and terminal block, all contained in a die cast aluminum enclosure.

c. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications.

d. Output shaft shall be electroless nickel plated to prevent corrosion.

e. Actuator shall have a motor rated for minimum 75% duty cycle. Duty cycle shall be defined as running time divided by installed time at maximum torque.

f. Actuator shall be suitable for operation in ambient temperature ranging from -22°F to +150°F.

g. A pre-wired cable shall bring wiring outside enclosure to avoid necessity of opening cover.

h. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.

i. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator.

When in manual operation electrical power to the actuator will be permanently interrupted.

j. The hand wheel will not rotate while the actuator is electrically driven.

k. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.

l. Provide limit (end) position switches where indicated on schematics.

m. Actuators shall provide clear visual indication of valve position.

5. Normal and Fail-Safe Position

a. Except as specified otherwise herein, the normal position (that with zero control signal) and the fail-safe position (that with no power to the actuator) of control devices and actuators shall be as indicated in table below. “Last” means last position. Actuators with a fail-safe position other than “Last” must have spring or electronic fail-safe capability.

Device	**Normal Position**	**Fail-Safe Position**
Outside air damper	CLOSED	CLOSED
Return air damper	OPEN	OPEN
Exhaust/relief air damper	CLOSED	CLOSED
AHU heating coil valves	OPEN	LAST
AHU cooling coil valves	CLOSED	LAST
Equipment isolation valves	OPEN	LAST
Minimum flow bypass valves	OPEN	LAST
VAV box dampers	OPEN	LAST

6. Valve Actuator Selection

a. Modulating actuators for valves shall have minimum rangeability of 50 to 1.

b. Water

1) 2-way, and two-position valves

a) Tight closing against 125% of system pump shut-off head.

b) Modulating duty against 90% of system pump shut-off head.

2) 3-way shall be tight closing against twice the full open differential pressure for which they are sized.

7. Damper Actuator Selection

a. Actuators shall be direct coupled. For multiple sections, provide one actuator for each section; linking or jack-shafting damper sections shall not be allowed.

b. Provide sufficient torque as velocity, static, or side seals require per damper manufacturer's recommendations and the following:

1) Torque shall be a minimum 5 inch-pound per square foot for opposed blade dampers and 7 inch-pound per square foot for parallel blade dampers.

2) The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating.

E. General Field Devices

1. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.

2. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

3. Field devices specified herein are generally two-wire type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with two-wire type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, provide a transmitter and necessary regulated DC power supply, as required.

4. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, 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.

5. Accuracy: As used in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis. Sensor accuracy shall be at or better than both that specifically listed for a device and as required by Paragraph 1.8B.2.

F. Temperature Sensors (TS)

1. General

a. Unless otherwise noted, sensors may be platinum RTD, thermistor, or other device that is commonly used for temperature sensing and that meets accuracy, stability, and resolution requirements.

b. When matched with A/D converter of BC, AAC, or ASC, sensor range shall provide a resolution of no worse than 0.3ºF (0.16 °C) (unless noted otherwise herein).

c. Sensors shall drift no more than 0.3ºF and shall not require calibration over a five-year period.

d. Manufacturers

1) Mamac

2) Kele Associates

3) Building Automation Products Inc.

4) Automated Logic Corp.

5) Or equal

2. Duct temperature sensors: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise.

a. TS-1A: Single point (use where not specifically called out to be averaging in points list). Sensor probe shall be 304 stainless steel.

b. TS-1B: Averaging. Sensor length shall be at least 1 linear foot for each 2 square feet of face area up to 25 feet maximum. Sensor probe shall be bendable aluminum.

3. Water Temperature Sensors

a. TS-2A: Well mounted immersion sensor, ¼" stainless steel probe, double encapsulated sensor, with enclosure suitable for location.

b. TS-2B: Same as TS-2A except provide extra precision (XP) temperature sensors to meet accuracy specified Paragraph 1.8B.2.

c. All piping immersion sensors shall be in one-piece machined brass or stainless steel wells that allow removal from operating system, with lagging extension equal to insulation thickness where installed in insulated piping. Wells shall be rated for maximum system operating pressure, temperature and fluid velocity. The well shall penetrate the pipe by the lesser of approximately half the pipe diameter or eight inches. The use of direct immersion or strap-on type sensors is not acceptable.

4. Room Sensors

   a. Thermostat tags refer to the following:

Type:	Tag	
Display	Blank	LCD
Temperature only	TS-3A	TS-3C
With humidity	TS-3AH	TS-3CH
With CO_2	TS-3AC	TS-3CC
With CO_2 and humidity	TS-3AHC	TS-3CHC

      1) Display

         a) Blank: Blank cover (or LCD display with display configured to be shut off and touchpad or keypad disabled)

         b) LCD: LCD display of all sensors, temperature setpoint adjustment buttons, and schedule override button

      2) Humidity Sensor

         a) 10% to 90%/±2% accuracy

         b) Where humidity sensor is not specified but included as standard, it shall be configured to not be displayed on the LCD or any graphics and not included in points list, as if it did not exist. (The purpose is to avoid the expense of having to keep the sensor in calibration.)

      3) CO2 Sensor

         a) 400 to 1250 PPM/ ±30PPM or 3% of reading, whichever is greater.

         b) The sensor shall include automatic background calibration (ABC) logic to compensate for the aging of the infrared source and shall not require recalibration for a minimum of 5 years, guaranteed. If sensor is found to be out of calibration, supplier shall recalibrate at no additional cost to the College within 5 years of purchase date.

         c) Meet Title 24 requirements including calibration interval

      4) For room sensors connected to terminal box controllers (such as at VAV boxes) that require calibration: Include a USB port or some other means for connection of POT for terminal box calibration. Alternative means of terminal calibration are acceptable provided they result in no cost to Work performed under Section 230593 Testing, Adjusting, and Balancing.

   b. See equipment schedules for thermostat type.

5. TS-4: Outdoor Air Sensor

a. Enclose in fan-aspirated radiation shield that combines both active and passive aspiration to minimize the effects of radiation.

1) Motor-driven fan draws air through the sensor chamber and exhausts it through the top of the shield.

2) Triple-walled sensor chamber shielded by flow-through plates.

3) Aspiration rate: minimum is 220 feet per minute.

b. Sensor

1) Electronics mounted in watertight gasketed enclosure to prevent water seepage

2) TS-1A where only drybulb temperature is specified in points list

3) TS-1A and HT-2 where drybulb temperature and relative humidity is specified in points list

4) TS-5 where both drybulb and dewpoint temperature is specified in points list

c. Manufacturer

1) Davis Instruments 7747

2) Kele A21

3) Or equal

6. Temperature Transmitters: Where required by the Controller or to meet specified end-to-end accuracy requirements, sensors as specified above shall be matched with transmitters outputting 4-20 mA linearly across the specified temperature range. Transmitters shall have zero and span adjustments, an accuracy of 0.1°F when applied to the sensor range.

G. Pressure Transmitters (PT)

1. PT-1: Water, General Purpose

a. Fast-response stainless steel sensor

b. Two-wire transmitter, 4-20 mA output with zero and span adjustments

c. Accuracy

1) Overall Accuracy (at constant temp) ±0.5% full scale, includes non-linearity, repeatability, and hysteresis

d. Long Term Stability 0.5% FS per year

e. Pressure Limits

1) Rated pressure: see points list

2) Proof pressure = 3x rated pressure

3) Burst pressure = 5x rated pressure

f. Manufacturers

1) Setra 209

2) Kele & Associates P51 Series

3) Or equal

H. Differential Pressure Transmitters (DPT)

1. DPT-1: Water, General Purpose

a. Fast-response capacitance sensor

b. Two-wire transmitter, 4-20 mA output with zero and span adjustments

c. Accuracy

1) Overall Accuracy (at constant temp) ±0.25% full scale (FS).

2) Non-Linearity, BFSL ±0.22% FS.

3) Hysteresis 0.10% FS.

4) Non-Repeatability 0.05% FS.

d. Long Term Stability 0.5% FS per year

e. Only 316 stainless steel in contact with fluid

f. Pressure Limits

1) 0 to 100 psid range: 250 psig maximum static pressure rating, 250 psig maximum overpressure rating.

2) 100 to 300 psid range: 450 psig maximum static pressure rating, 450 psig maximum overpressure rating.

g. Include brass 5-valve assembly for single sensor devices. See Paragraph 3.12E.9.

h. Manufacturers

1) Setra 209 or 230

2) Modus W30

3) Or equal

2. DPT-2: Not used

3. DPT-3: Air, Duct Pressure:

a. General: Loop powered two-wire differential capacitance cell-type transmitter.

b. Output: two wire 4-20 mA output with zero adjustment.

c. Overall Accuracy: ±1% of range (not of maximum range/scale)

d. Switch selectable range:

1) ≥ 0.5 inches water column

2) ≤10 inches water column

3) Select range as specified in points list or, if not listed for specified setpoint to be between 25% and 75% full-scale.

e. Housing: Polymer housing suitable for surface mounting.

f. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301, Davis Instruments, or equal, with connecting tubing.

g. DPT-3A: Include LCD display of reading.

4. DPT-4: Air, Low Differential Pressure

a. General: Loop powered, two-wire differential capacitance cell type transmitter.

b. Output: Two-wire 4-20 mA output with zero adjustment.

c. Overall Accuracy

1) General: ±1% FS

2) Underfloor: ±0.5% FS

3) Minimum outdoor air damper DP used for minimum outdoor airflow: ±0.25% FS

d. Range

1) Fixed (non-switch selectable)

2) Minimum Range: 0, -0.1, -0.25, -0.5, or -1.0 inches water column

3) Maximum Range: +0.1, 0.25, 0.5, or 1.0 inches water column

4) Range shall be as specified in points list or, if not listed, selected such that specified setpoint is between 25% and 75% full-scale.

e. Housing: Polymer housing suitable for surface mounting

f. Static Sensing Element

1) Ambient sensor: Dwyer A-306 or 420, BAPI ZPS-ACC-10, or equal

2) Space sensor:

a) Wall plate: Kele RPS-W, BAPI ZPS-ACC-01, Dwyer A-417 or 465 or equal

b) Ceiling or wall probe: BAPI ZPS-ACC06, Dwyer A-419A, Veris AA05 or equal

3) Filter or duct pressure sensor: Dwyer A-301 or equal

4) Plenum pressure sensor: Dwyer A-421 or equal

g. DPT-4A: Include LCD display of reading

h. Manufacturers

1) Setra 267

2) Modus

3) Air Monitor

4) Paragon

5) Or equal

5. DPT-5: VAV Velocity Pressure

a. General: Loop powered two-wire differential capacitance cell type transmitter.

b. Output: Two-wire, 4-20 mA output with zero adjustment.

c. Flow transducer (including impact of A-to-D conversion) shall be capable of stably controlling to a setpoint of 0.004 inches differential pressure or lower, shall be capable of sensing 0.002 inches differential pressure or lower, and shall have a ±0.001 inches or lower resolution across the entire scale.

d. Calibration software shall use a minimum of two field measured points, minimum and maximum airflow, with curve fitting airflow interpolation in between.

e. Range: 0 to 1 in.w.c.

f. Housing: Polymer housing suitable for surface mounting.

g. Manufacturer

1) Automated Logic or Distech

2) No equal

I. Differential Pressure Switches (DPS)

1. DPS-1: Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential, and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range. 0ºF to 160ºF operating temperature range.

2. DPS-2: Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Automatic reset. Provide manufacturer's recommended static pressure sensing tips and connecting tubing.

J. Current Switches (CS-1)

1. Clamp-on or solid-core

2. Range: as required by application

3. Trip Point: Automatic or adjustable

a. Exception: Fixed setpoint (Veris H-600 or equal) may be used on direct drive constant speed fans that do not have backdraft or motorized shutoff dampers.

4. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage

5. Lower Frequency Limit: 6 Hz

6. Trip Indication: LED

7. Approvals: UL, CSA

8. May be combined with relay for start/stop

9. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing with override switch. Kele RIBX, Veris H500, or equal

10. Manufacturers

    a. Veris Industries H-608/708/808/908

    b. Senva C-2320L

    c. RE Technologies SCS1150A-LED

    d. Or equal

K. Current Transformers (CT-1)

1. Clamp-On Design Current Transformer (for Motor Current Sensing)

2. Range: 1-10 amps minimum, 20-200 amps maximum

3. Trip Point: Adjustable

4. Output: 0-5 Vdc or 0-10 Vdc,

5. Accuracy: ±0.2% from 20 to 100 Hz.

6. Amperage range sizing and switch settings in accordance with the following and per manufacturer's instructions:

Motor HP	120V	277V	480V
≤1/2	0-10A	0-10A	–
3/4 – 1.5	–	0-10A	0-10A
2 – 5	–	–	0-10A
7.5 – 10	–	–	0-20A
15 – 20	–	–	0-30A
25 – 30	–	–	0-40A

7. Manufacturers

    a. Veris Hx22 series

    b. Kele SC100

    c. Or equal

L. Flow Meter (FM)

1. FM-1: Magnetic Flow Tube Flow Meters

    a. General Requirements

1) Sensor shall be a magnetic flow meter, which utilizes Faraday's Law to measure volumetric fluid flow through a pipe. The flow meter shall consist of 2 elements, the sensor and the electronics. The sensor shall generate a measuring signal proportional to the flow velocity in the pipe. The electronics shall convert this EMF into a standard current output.

2) Electronic replacement shall not affect meter accuracy (electronic units are not matched with specific sensors).

3) Provide a four-wire, externally powered, magnetic type flow transmitter with adjustable span and zero, integrally mounted to flow tube. Output signal shall be a digital pulse proportional to the flow rate (to provide maximum accuracy and to handle abrupt changes in flow). Standard 4-20 mA or 0-10 Vdc outputs may be used on HVAC applications provided accuracy is as specified.

    a) On applications where the output is wired to a BTU meter but flow is required also as a direct input to the DDC system, e.g. for minimum flow control loop, provide a secondary analog output for the DDC system.

4) Flow Tube

    a) ANSI class 150 psig steel

    b) ANSI flanges

    c) Lined with

        1. Heating hot water, glycol: PTFE, PFA, or ETFE liner rated for ≤-4°F to ≥212ºF fluid temperature

        2. Chilled, condenser, domestic hot and cold water: Polypropylene, Ebonite, PTFE, PFA, or ETFE liner rated for ≤32°F to ≥140ºF fluid temperature

5) Electrode and grounding material

    a) 316L Stainless steel or Hastelloy C

    b) Electrodes shall be fused to ceramic liner and not require O-rings.

6) Electrical Enclosure: NEMA 4

7) Approvals

    a) UL or CSA

    b) NSF Drinking Water approval for domestic water applications

8) Performance

a) Accuracy shall be:

1. ±0.4% of reading from 3.3 to 33 ft/s

2. ±0.75% of reading from 1.3 to 3.3 ft/s

3. ±0.0075 ft/s at flow rates less than 1 ft/s

b) Stability: 0.1% of rate over six months.

c) Meter repeatability shall be ± 0.1% of rate at velocities > 3 feet per second.

d) Calibration: The sensor must be factory calibrated on an internationally accredited (such as NAMAS) water flow rig with accuracy better than 0.1%. Calibration shall be NIST traceable.

b. Manufacturers

1) Onicon F-3100 series

2) Siemens/Danfoss Magflo 3100

3) Krohne Optiflux 4000

4) Sparling TigermagEP FM656

5) Or equal

M. Airflow Measuring Stations (AFMS)

1. General. AFMS provided under this Section shall be licensed to bear the AMCA Certified Rating Seal for Airflow Measuring Stations. Ratings shall be based on tests and procedures performed in accordance with AMCA Publication 611 and comply with requirements of the AMCA Certified Ratings Program.

2. AFMS-1

a. Differential pressure type with uniframe DP sensor

1) Provide quantity of DP sensors per manufacturer's recommendations

b. Station mounted with expanded metal screen

c. Analog outputs for "standard" airflow (0.075 lb_{da}/ft3 density) and temperature

d. Manufacturers

1) Air Monitor

a) Transmitter: OAM-II-2121-1BMMM

b) Airflow Measuring System: OAM-II-AFS-(XX)A-111-013 where “XX” varies with the associated opening dimensions.

2) No equal

N. Electric Control Components

1. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley, or equal.

2. Line-Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT contacts rated for 120V and current as required for application, temperature setpoint range of 50 to 90ºF.

3. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.

a. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:

1) AC coil pull-in voltage range of +10%, -15% or nominal voltage.

2) Coil sealed volt-amperes (VA) not greater than 4 VA.

3) Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.

4) Pilot light indication of power-to-coil and coil retainer clips.

b. 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.

c. 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.

4. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1 enclosure. Manufacturer shall be Square D, Cutler-Hammer, or equal.

5. Control Transformers and Power Supplies

a. Control transformers shall be UL Listed. Furnish Class 2 current-limiting type, or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Mount in minimum NEMA-1 enclosure.

b. Transformer shall be proper size for application. Limit connected loads to 80% of rated capacity.

c. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection, and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.

d. Separate power transformer shall be used for controllers and for actuators and other end devices that use half wave rectification.

e. Unit shall operate between 0°C and 50°C [32°F and 120°F]. EM/RF shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810C for shock and vibration.

f. Line voltage units shall be UL Recognized and CSA Approved.

6. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley, Kele, or equal.

7. Mechanical Timer Switch: Switch shall be mechanically spring wound with a N.O. contact or N.C. contacts as required. Timer shall be 0-60 minutes and shall not include a “hold” feature, which allows switch contacts to remain closed. Contacts shall be rated for minimum 120 VAC operation. Switch shall be C560M type, as manufactured by NSI Industries or equal.

8. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley, Kele, or equal.

9. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, Sonalert solid-state electronic signal, as manufactured by Mallory, Kele, or equal.

10. Potentiometer. Wall box mounted single turn with knob numbered 0 to 10 or 0 to 100. Wall plate cover to match electrical.

11. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley, Kele, or equal.

12. Window switch (WS)

    a. Surface mount magnetic burglar alarm switch.

    b. Screw mount, magnet on window, switch on frame.

    c. Sealed to prevent dirt or dust contact.

    d. Color to match electrical and lighting switch plates in the room. See Division 26 and Electrical Drawings.

2.10 CALIBRATION & TESTING INSTRUMENTATION

A. Provide instrumentation required to verify readings, calibrate sensors, and test the system and equipment performance.

B. 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.

C. 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 ±0.5% accurate, test equipment shall be ±0.25% accurate over same range).

2.11 SOFTWARE

A. General

1. System software shall be based on a server/thin-client architecture, designed around the open standards of web technology. Servers shall be accessed using a web browser over the control system Supervisory LAN, the Owner's IT LAN, and remotely over the Internet (through the Owner's IT LAN).

2. The intent of the thin-client architecture is to provide operators complete access to the BAS via a web browser GUI. No special software other than a web browser (including ActiveX components or fat java clients) shall be required to be installed on OIs used to access the BAS graphics, point displays, trends, and trend configuration. Additional software other than a browser may be used to configure or modify the BAS and programming.

3. The interface software shall be certified by the BACnet Testing Laboratory as an Advanced Operator Workstation Software (B-AWS) under ANSI/ASHRAE Standard 135.

4. Furnish and install all software and programming necessary to provide a complete and functioning system as specified. Include all software and programming not specifically itemized in these specifications that is necessary to implement, maintain, operate, and diagnose the system in compliance with these specifications.

5. Software Components: All software components of the BAS system software shall be installed and completed in accordance with the specification. BAS system components shall include:

    1) Server Software, Database and Web Browser Graphical User Interface

    2) System Configuration Utilities for future modifications to the system

    3) Programming language

    4) Direct digital control software

    5) Application Software

B. Licensing

1. Include licensing and hardware keys for all software packages at all workstations (OWSs and POTs) and servers.

2. Within the limitations of the server, provide licenses for any number of users to have web access to the CSS at any given time.

3. All operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the College.

4. All operator software, including that for programming and configuration, shall be available on all workstations. Hardware and software keys to provide all rights shall be installed on all workstations.

C. Controller Software

1. BC Software Residency: Each BC shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:

    a. Real-Time Operating System software

    b. Real-Time Clock/Calendar and network time synchronization

    c. BC diagnostic software

    d. LAN Communication software/firmware

    e. Direct Digital Control software

    f. Alarm Processing and Buffering software

    g. Data Trending, Reporting, and Buffering software

h. I/O (physical and virtual) database

i. Remote Communication software

2. AAC/ASC Software Residency: Each AAC/ASC shall be capable of control and monitoring of all points physically connected to it. As a minimum, software including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device (specified in Paragraph 2.4A) with the restrictions and exceptions per application provided in Paragraph 2.3D:

   a. Real-Time Operating System software

   b. AAC/ASC diagnostic software

   c. LAN Communication software

   d. Control software applicable to the unit it serves

   e. I/O (physical and virtual) database to support one mode of operation

3. Standalone Capability: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC or other communication links to other BCs/AACs/ASCs. Trends and runtime totalization shall be retained in memory. Runtime totalization shall be available on all digital input points that monitor electric motor status. Refer also to Paragraph 2.3 for other aspects of standalone functionality.

4. Operating System: Controllers shall include a real-time operating system resident in ROM or EEPROM. This software shall execute independently from any other device in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions. Refer also to Paragraph 2.3 for other aspects of the controller's operating system.

5. Network Communications: Each controller shall include software or firmware that supports the networking of CUs on a common communications trunk that forms the respective LAN. Network support shall include the following:

   a. Building Controller/Primary LAN shall be a high-speed network designed and optimized for control system communication. If a Primary LAN communications trunk is severed, BCs shall reconfigure into two separate LANs and continue operations without interruption or Operator intervention.

   b. Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.

   c. Operator/System communication software shall facilitate communications between other BCs, all subordinate AACs/ASCs, Gateways and LAN

Interface Devices or Operator Workstations. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is on line and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share selected physical and virtual point information throughout the entire system.

6. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions.

7. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as specified below.

8. Application Programs: CUs shall support and execute application programs specified herein.

9. Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be uploadable/downloadable from an OWS or CSS using BACnet services connected locally, to the Primary LAN, to the Local Supervisory LAN but all must be available. Initiation of an upload or download shall include all of the following methods; Manually, Scheduled, and Automatically upon detection of a loss or change.

10. Power Loss and Restart: System software shall provide for orderly shutdown upon loss of power. Volatile memory shall be retained. Outputs shall go to programmed fail position, which as a default shall be set to their position in unoccupied mode. Equipment restart shall be automatic upon power restoration and shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be alarmed at operator interface indicating date and time.

11. Time Synchronization: Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network or all devices simultaneously. Automatic time synchronization shall be provided using BACnet services.

12. Anti-dithering: In order to improve the life expectancy of modulating electronic actuators, software shall limit the number of re-positions. This can be accomplished by providing anti-dithering software, a small deadband for fully proportioning actuators, and by ensuring that floating actuators do not receive control pulses of excessively short duration.

D. Graphical User Interface Software

1. A web browser installed on each OWS, POT, and server (see Paragraph 2.1A) shall serve as the graphical user interface to the BAS. Communication between the web server GUI and BAS server shall be encrypted using 128-bit encryption technology within Secure Socket Layers. Communication protocol shall be Hyper-Text Transfer Protocol.

2. The GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to have a look-and-feel like a single application and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish all features specified in this section.

3. The GUI shall (as a minimum) provide a Navigation Pane for navigation, and an Action Pane for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events.

4. Login: Upon launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges, and geographic area of responsibility. See Security Access below.

5. Navigation Pane

    a. The Navigation Pane shall comprise a Navigation Tree which defines a geographic hierarchy of the BAS system. Navigation through the GUI shall be accomplished by clicking on appropriate level of a navigation tree (consisting of expandable and collapsible tree control like Microsoft's Explorer program) or by selecting dynamic links to other system graphics. Both the navigation tree and action pane defined below shall be displayed simultaneously enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views:

        1) Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and BACnet objects.

        2) Network View shall display the hierarchy of the actual BACnet IP Intranet network. This can include: Systems, Site, Networks, Routers, Half-Routers, Devices, Equipment and all the BACnet Objects in a device.

        3) Groups View shall display Scheduled Groups and custom reports.

        4) Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).

    b. Alternative interface structures will also be accepted if they provide similar ease of navigation through the system hierarchy.

6. Action Pane: The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. A functional view shall be accessed by clicking on the corresponding buttons:

a. Graphics: Using animated png or other graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh at least 6 times per minute.

b. Properties: Shall include graphic controls and text for the following: Locking or overriding BACnet objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an accept/cancel button.

c. Schedules: Shall be used to create, modify, edit and view schedules based on the systems geographical hierarchy and in compliance with Paragraph 2.11D.8.

d. Events: Shall be used to view alarm event information geographically (using the navigation tree), acknowledge events, sort events by category, actions and verify reporting actions.

e. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling.

f. Logic - Live Graphic Programs: Shall be used to display a real-time graphic of the control algorithm for the mechanical/electrical system selected in the navigation tree.

7. Graphics

a. The GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated graphics and active setpoint graphic controls shall be used to enhance usability.

b. Graphics tools used to create Web Browser graphics shall be non-proprietary and provided and installed on each OWS.

c. Graphical display shall be 1280 x 1024 pixels or denser, 256 color minimum.

d. Links

1) Graphics shall include hyperlinks which when selected (clicked on with mouse button) launch applications, initiate other graphics, etc.

2) Screen Penetration: Links shall be provided to allow user to navigate graphics logically without having to navigate back to the home graphic. See additional discussion in Paragraph 3.13E.

3) Information Links

a) On each MEP system and subsystem graphic, provide links to display in a new window the information listed below.

1. English-language as-built control sequence associated with the system. See Paragraph 1.7B.

2. O&M and submittal information for the devices on the graphic. See Paragraph 1.7B. This includes links to electronic O&M and submittal information for mechanical equipment supplied under Section 230501 Basic Mechanical Materials and Methods.

b) The display shall identify the target of the link by file name/address.

c) Information shall be displayed in electronic format that is text searchable.

d) Window shall include software tools so that text, model numbers, or point names may be found. Source documents shall be read-only (not be editable) with this software.

e. Point Override Feature

1) Every real output or virtual point displayed on a graphic shall be capable of being overridden by the user (subject to security level access) by mouse point-and-click from the graphic without having to open another program or view.

2) When the point is selected to be commanded

a) Dialog box opens to allow user to override the point (Operator Mode) or release the point (Automatic Mode). Operator Mode will override automatic control of the point from normal control programs.

b) Dialog box shall have buttons (for digital points) or a text box or slide bar (for analog points) to allow user to set the point's value when in operator mode. These are grayed out when in automatic mode.

c) When dialog box is closed, mode and value are sent to controller.

d) Graphic is updated upon next upload scan of the actual point value.

3) A list of points that are currently in an operator mode shall be available through menu selection.

f. Point override status (if a digital point is overridden by the supervised manual override per Paragraph 2.3C or if a point is in operator mode per Paragraph 2.11D.7.e) shall be clearly displayed on graphics for each point, such as by changing color or flag.

g. The color of symbols representing equipment shall be able to change color or become animated based on status of binary point to graphically represent on/off status.

h. On floor plan displays of spaces, temperature shall be graphically displayed by coloring the zone area in accordance with or similar to the following:

1) Red: space temperature above cooling setpoint by 2ºF (adjustable) or more. This condition can be programmed to generate an alarm.

2) Yellow: space temperature between cooling setpoint and 2ºF (adjustable) above setpoint.

3) Green: space temperature between cooling and heating setpoints and space is in occupied mode.

4) Gray: space temperature between cooling and heating setpoints and space is in unoccupied mode.

5) Light blue: space temperature between heating setpoint and 2ºF (adjustable) below setpoint.

6) Dark blue: space temperature below heating setpoint by 2ºF (adjustable) or more. This condition can be programmed to generate an alarm.

8. Graphics Development Package

a. Graphic development and generation software shall be provided to allow the user to add, modify, or delete system graphic displays.

b. Provide capability to store graphic symbols in a symbol directory and incorporate these symbols into graphics.

c. Provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (such as fans, cooling coils, filters, dampers), mechanical system components (such as, pumps, chillers, cooling towers, boilers), complete mechanical subsystems (such as VAV reheat zone) and electrical symbols.

d. The Graphic Development Package shall use a mouse or similar pointing device to allow the user to perform the following:

1) Define symbols

2) Position items on graphic screens

3) Attach physical or virtual points to a graphic

4) Define background screens

5) Define connecting lines and curves

6) Locate, orient and size descriptive text

7) Define and display colors for all elements

8) Establish correlation between symbols or text and associated system points or other displays.

9) Create hot spots or link triggers to other graphic displays or other functions in the software.

e. A single graphic file shall be used for common control applications (such as VAV boxes) so that any updates to the graphic may be done once and automatically applied to all applications. Displayed points shall be automatically populated based on wild card entry of point name in graphic definition.

9. Time and Schedules

a. Provide a time master that is installed and configured to synchronize the clocks of all BACnet devices supporting time synchronization. Synchronization shall be done using Coordinated Universal Time. All trend sample times shall be able to be synchronized. The frequency of time synchronization message transmission shall be selectable by the operator.

b. System shall automatically change time/date for Daylight Savings Time and leap years.

c. An operator (with password access) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor Zone Group. For example, Independence Day Holiday for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the Independence Day Holiday.

d. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.

e. Schedules shall comply with the BACnet standard, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on

1) Types of schedule shall be Normal, Holiday or Override

2) A specific date

3) A range of dates

4) Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any)

5) Wildcard (example, allow combinations like second Tuesday of every month)

f. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of systems or occupancy types). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.

g. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an individual Tenant Group – who may occupy different areas within a building or buildings. Schedules applied to the Tenant Group shall automatically be downloaded to control modules affecting spaces occupied by the Tenant Group.

h. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (example: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).

i. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules, and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.

j. Schedule Distribution: For reliability and performance, instead of maintaining a single schedule in a field device that writes over the network to notify other devices when a scheduled event occurs, field devices will only keep their part of the schedule locally. The BAS server software shall determine which nodes a hierarchical schedule applies to and will create/modify the necessary schedule objects in each field device as necessary.

10. Events and Alarms

a. Events and alarms associated with a specific system, area, or equipment selected in the Navigation Tree shall be displayed in the Action Pane by selecting an Events View.

b. Events View: Each event shall display an Event Category (using a different icon for each event category), date/time of occurrence, current status, and event report. An operator shall be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.

c. Event Categories (Alarm Levels): The operator shall be able to create, edit or delete event categories (alarm level). An icon shall be associated with each Event category, enabling the operator to easily sort through multiple events displayed. Alarm levels (per Guideline 36) shall be initially configured by the Contractor as follows:

   1) Level 1: Life Safety Message

   2) Level 2: Critical Equipment Message

   3) Level 3: Urgent Message

   4) Level 4: Normal Message

d. BACnet Event Templates: BACnet Event template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of event, acknowledgement requirements, high/low limit and out of range information.

e. Event Areas (Actions): Each Event Categories (Alarm Level) shall be configured to specific Event Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance events on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Event Areas in the Graphic Pane.

f. Alarm Configuration. Alarms shall require configuration related to criticality (Critical/Not Critical), operator acknowledgement (Requires Acknowledgement/Does Not Require Acknowledgement), and conditions required for an alarm to clear automatically (Requires Acknowledgement of a Return to Normal/ Does Not Require Acknowledgement of a Return to Normal).

g. Event Reporting Actions: Event Reporting Actions specified shall be automatically launched (under certain conditions) after an event is received by the BAS server software. Operators shall be able to define these Reporting Actions using the Navigation Tree and Graphic Pane through the GUI. Reporting Actions shall be as follows:

   1) GUI dialog box: Provide visual and optional audible alarm indication. The alarm dialog box shall always become the top dialog box upon receipt of an alarm irrespective of the foreground application.

   2) Print: Alarm/Event information shall be printed to the any network accessible printer.

   3) Email: Alarm/Event information shall be via email to a POP3 address on the Owner's intranet or through this intranet to the internet.

   4) Text: Alarm/Event information shall be sent to phone via SMS services.

5) File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).

6) Write Property: The write property reporting action updates a property value in a hardware module.

7) Run External Program: The Run External Program reporting action launches specified program in response to an event.

h. Event Time/Date Stamp: All events shall be generated at the BAS control module level and comprise the Time/Date Stamp using the standalone control module time and date.

i. Event Configuration: Operators shall be able to define the type of events generated per BACnet object. A network view of the Navigation Tree shall expose all BACnet objects and their respective Event Configuration. Configuration shall include assignment of event, alarm, type of acknowledgement and notification for return to normal or fault status.

j. Event Summary Counter: The view of events in the Graphic Pane shall provide a numeric counter, indicating how many events are active (in alarm), require acknowledgement, and total number of events in the BAS Server database.

k. Event Auto-Deletion: Events that are acknowledged and closed, shall be auto-deleted from the database and archived to a text file after an operator defined period. The file shall be stored in file on the CSS with no limit to quantity or age of alarms, other than limitations of hard disk. The file can be archived to tape and deleted by operator to clear disk space.

l. Data Format. The system shall allow for external systems to access the event instance data. Event data shall be stored and queried in the database in a relational manner. At a minimum, the fields to be stored in the database are

1) Event Source

2) Event Generation Time

3) Acknowledge Required Flag

4) Delivery Priority

5) BACnet Event Type

6) Event Message Text

7) BACnet Event Parameter

8) Classification of Event

9) Event Acknowledgement Time

10) Return to Normal Time

11) Operator Comments

12) Who Acknowledged the Event

m. Event Simulator: The GUI user shall provide an Event Simulator to test assigned Reporting Actions. The operator shall have the option of using current time or scheduling a specific time to generate the Event. Utilizing the Navigation Tree and drop-down menus in the Graphic Pane, the operator shall be able to select the Event Type, Status, Notification, Priority, Message, and whether acknowledgement is required.

11. Trends

a. Trending and trend analysis capabilities are considered critical to system performance. The system shall be designed to upload and record large amounts of point data without causing network bottlenecks or affecting proper system operation. Data shall be stored on the CSS. The system as a whole shall be designed to comply with the trending capability test defined in Paragraph 3.15H.

b. Every point, both real and virtual, shall be available for data trending.

c. Trending software shall be capable of recording point values and time on a user specified regular time step and on a change-of-value (COV) basis (data is recorded when point changes by a specified amount for analog points or by changes of state for binary points), at the user's option. Sampling intervals shall be as small as one second. Each trended point shall have the ability to be trended at a different sampling interval.

d. Trend data shall be sampled and stored in control panel memory (see Paragraph 2.3). If historical trending is enabled for the BACnet object, trend data shall be uploaded from control panels to the CSS on a user-defined interval, manual command, or automatically when the trend buffer becomes full. There shall be no limit to the amount of trend data stored at the CSS other than hard disk limitations.

e. Trends shall conform to the BACnet Trend Log Object specification. Trends shall both be displayed and user configurable through the GUI. Trend logs may comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.

f. Viewing Trends

1) Trend data shall be displayed graphically by the GUI. This shall be a capability internal to the workstation software and not a capability resulting from download of trend data on a third-party spreadsheet program unless such transfer is automatic and transparent to the operation and the third-party software is included with the workstation software package.

2) The software shall be capable of dynamically graphing the trend logged object data by creating two-axis (x, y) graphs that simultaneously display values relative to time for at least eight objects in different colors, even if objects have been trended at different time intervals. Where trended values are COV, software shall automatically fill the trend samples between COV entries. A graph legend shall identify each variable plotted.

3) 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.

4) Trend format, displayed points, etc. shall be capable of being saved as a template for future trend displays.

5) Trends shall be able to dynamically update at operator-defined intervals, including on a 1 second interval for loop tuning.

6) 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.

7) It shall be possible to pick (or float mouse over) any sample on a trend and have the numerical value displayed.

8) The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard Windows keystrokes.

g. Trend Data Storage

1) The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the BAS using SQL queries.

2) Data shall be stored in an SQL compliant database format and shall be available through the Owner’s intranet or internet (with appropriate security clearance) without having to disable BAS access to the database.

3) The database shall not be inherently limited in size, e.g. due to software limitations or lack of a correct license. Database size shall be limited only by the size of the provided storage media (hard drive size).

h. Data export. Trends shall be exportable using one or more of the following methods:

1) SQL Query

a) Provide the exact syntax to allow extraction of data from the database in 4-column format as shown in Table 1 below.

b) Provide a windows-compatible ODBC driver for the database along with the installation of the database itself.

TrendName	DateTime	TimeZone	DataValue
B8.Plant.CH3.CHWS.Temp.F	2009-06-16 13:01:02	-0800	43.5
B8.Plant.CH3.CHWS.Temp.F	2009-06-16 13:06:06	-0800	45.2
B8.Plant.CH3.CHWS.Temp.F	2009-06-16 13:11:01	-0800	44.3

Table 1: Example of a database presentation

12. Security Access

a. Security access from the GUI to BAS servers shall require a Login Name and Password.

b. Access to different areas of the BAS shall be defined in terms of roles and geographic area of responsibility.

c. Roles shall reflect the actual roles of different types of operators. Roles shall be defined in terms of View, Edit and Function Privileges.

1) View Privileges: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.

2) Edit Privileges: Setpoint, Tuning and Logic, Manual Override, and Point Assignment Parameters.

3) Function Privileges: Alarm/Event Acknowledgement, Control Module Configuration, Memory Download and Upload, Schedules, Schedule Groups, Manual Commands, Print, and Alarm/Event Maintenance.

d. Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

e. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected for an adjustable period of time. This auto logoff time shall be set individually per operator.

f. Provide an audit trail of actions taken by any user, including the user name and time. Store in secure file in database format on the CSS. Provide software to view and print audit trail.

13. Report Software

a. Provide software to create standard and custom reports of point status, alarms, etc. Report format, displayed points, time period (daily, weekly, monthly, or annual), etc. shall be capable of being saved as a template for future reports. Reports shall be time and date stamped and shall contain a report title editable by the user.

b. Reports shall be capable of being sent to a printer or export to Word or ASCII format to a file, and shall be capable of being generated automatically based on date and time of day.

c. Standard reports. Prepare the following standard reports, accessible automatically without requiring definition by user.

1) Tenant or department after-hour usage. System must be capable of monitoring tenant override requests and generating a monthly report showing the daily total time in hours that each tenant has requested after-hours HVAC services.

2) Monthly and annual energy usage and cost. See Utility cost calculation in Paragraph 3.13.

3) Alarm events and status.

4) Points in Hand (Operator Override) via Workstation command (including name of operator who made the command) or via supervised HOA switch at output, including date and time.

E. Control Programming Software

1. Points

a. Provide templates customized for point type, to support input of individual point information using standard BACnet Objects, including long-name field.

b. All real and virtual points shall be accessible to any control panel for use in any control sequences regardless of physical location.

2. Programming Language

a. All controllers must be fully user-programmable using a single programming language for all control devices. Use of canned (preprogrammed, burned-in) software is not acceptable.

b. The control programming language must allow virtually any control sequences to be written. Software shall be capable of the sequences specified in Paragraph 3.13 without exception.

c. All custom programs shall be modifiable from Operator Workstations without having to burn chips or locally access the controller. Software shall allow the user to modify and input control sequence software and to download to panels via the control network.

d. The programming language shall support floating point arithmetic using the following operators and functions: +, -, /, x, square root, and x-to-the-y-power, natural log, log, trigonometric functions (sine, cosine, tangent), absolute value, minimum/maximum value from a list of values, and psychrometric parameters (wetbulb, dewpoint, and enthalpy) from temperature and relative humidity.

e. The programming language shall have predefined variables that represent time of day, day of the week, month of the year, and the date. Other predefined variables shall provide elapsed time in seconds, minutes, hours, and days. These elapsed time variables shall be able to be reset by the language so that interval timing functions can stopped and started within a program.

f. The system must be capable of supporting software (virtual) points to be used in control sequences and monitored just as if they were real digital or analog points.

g. Control programming shall employ the BACnet protocols for Standard Command Priorities.

h. A PID (proportional-integral-derivative) algorithm with adjustable gains and anti-windup shall be included as an integral part (subroutine) of the programming language, not requiring special programming or hardware.

i. The programming language shall be graphical. BASIC-like or other line- or block-type programming languages are not acceptable. With the graphical programming language, a sequence of operations shall be created by drag-and-drop assembling on screen of graphic blocks that represent each of the commands or functions necessary to complete a control sequence. Blocks represent common logical control devices such as relays, switches, high signal selectors, PID loops, optimum start, etc. Blocks are then interconnected on screen using graphic “wires,” each forming a logical connection. Once assembled, each logical grouping of graphic blocks and their interconnecting wires then forms a graphic function block which may be

used to control any piece of equipment with a similar point configuration and sequence of operation.

j. The graphic programming software shall support a live mode, where all input/output data, calculated data, and setpoints shall be displayed in a real-time mode. For each piece of HVAC equipment, the entire graphic program shall be displayed through the GUI. The operator must have the ability to scroll through the entire live graphic program as necessary.

3. Debugging Software

a. Provide a search capability that will search all control sequences for a given point name to determine all sequences that use or control the point.

b. The control programs shall be capable of being tested on-line or off-line (prior to installation in field panels). The program and results of programming tests shall be displayed graphically using graphical programming language with parameter values displayed in appropriate locations. Simulation capabilities shall include step-by-step, accelerated time, and operator defined simulation criteria like outside weather, demand, and communication status.

F. Miscellaneous Software

1. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide relevant data for the application or object that help is being called from.

2. Provide software for viewing (but not editing) electronic versions of as-built shop drawings of

a. Mechanical, electrical, and plumbing systems in Adobe pdf format

b. BAS drawings in Adobe pdf format

3. Automatic Demand Response (ADR) Control Software

a. The software shall allow OpenADR communication from PG&E's Demand Response Automation Server through the College's LAN to the CSS, communicating at least the minimum points shown in Paragraph 2.12C.5.

2.12 CONTROL POINTS

A. Table Column Definitions

1. Point description

2. Type (number in point schedule after each type refers to tag on schematics)

a. AO: analog output

b. AI: analog input

c. DO: digital or binary output

d. DI: digital or binary input

3. Device description

   a. See Paragraph 2.9 for device definition.

4. Trend Logging

   a. Commissioning: Where listed, point is to be trended at the basis listed for commissioning and performance verification purposes.

   b. Continuous: Where listed, point is to be trended at the basis listed continuously, initiated after system acceptance, for the purpose of future diagnostics.

   c. Trend Basis

      1) Where range of engineering units is listed, trend on a change of value (COV) basis (in other words record time stamp and value when point value changes by engineering unit listed).

      2) Where time interval is listed, trend on a time basis (in other words record time stamp and value at interval listed). All points relating to a specific piece of equipment shall be trended at the same initiation time of day so data can be compared in text format.

5. Calibration

   a. F = factory calibration only is required (no field calibration)

   b. HH = field calibrate with handheld device. See Paragraph 3.15D.6.a.2)

B. Note that points lists below are for each system of like kind. Refer to drawings for quantity of each.

C. Points mapped through gateways and network interfaces. Note that points listed herein are intended to indicate the level of effort required for point mapping for bid purposes; the points lists are not exclusive and exhaustive. The exact point names and types may vary since the points available vary by equipment manufacturer and model. A final list of available points must be obtained from the manufacturer during the shop drawing development phase. If the available points differ from the points lists herein, the desired points to be mapped shall be confirmed by the Engineer prior to issuing Submittal Package 2. Unless the quantity of points is significantly different

from those shown herein, the changes shall be made at no additional costs to the College.

1. Variable speed drives

Description	Type	Device	Trend Logging		Calibra-tion
			Comm-issioning	Contin-uous	
Fault reset	DO	Through network	COV	COV	–
On/off status	DI	Through network	COV	COV	–
Fault (critical alarm)	DI	Through network	COV	COV	–
Minor alarm	DI	Through network	COV	COV	–
Fault text	AI	Through network (convert code to plain English text)	COV	COV	–
Alarm text	AI	Through network (convert code to plain English text)	COV	COV	–
Keypad in hand/auto	DI	Through network	COV	COV	–
Minimum frequency setpoint	AO	Through network	±5%	±5%	–
Maximum frequency setpoint	AO	Through network	±5%	±5%	–
Acceleration rate	AO	Through network	±5%	±5%	–
Deceleration rate	AO	Through network	±5%	±5%	–
Actual frequency	AI	Through network	1 min	15 min	–
DC bus voltage	AI	Through network	±10%	±10%	F
AC output voltage	AI	Through network	±10%	±10%	F
Current	AI	Through network	15 min	60 min	F
VFD temperature	AI	Through network	60 min	60 min	F
Power, kW	AI	Through network	1 min	15 min	F
Energy, MWh	AI	Through network	15 min	60 min	–

2. VRF System

Description	Type	Device	Trend Logging		Calibra-tion
			Comm-issioning	Contin-uous	
Condensing Unit Mode	AI	Through network	1 min	15 min	–
Compressor Status	DI	Through network	COV	COV	–
Fan Coil On/Off Command (Each Fan Coil)	DO	Through network	COV	COV	–
Fan Coil On/Off Status (Each Fan Coil)	DI	Through network	COV	COV	–
Alarm Status (Each Fan Coil)	DI	Through network	COV	COV	–
Alarm Code (Each Fan Coil)	AI	Through network	COV	COV	–

Description	Type	Device	Trend Logging		Calibra-tion
			Comm-issioning	Contin-uous	
Room Temperature (Each Fan Coil)	AI	Through network	1 min	15 min	F
Room Cooling Setpoint (Each Fan Coil)	AO	Through network	1 min	15 min	–
Room Heating Setpoint (Each Fan Coil)	AO	Through network	1 min	15 min	–
Fan Speed Setpoint (Each Fan Coil)	AO	Through network	1 min	15 min	–
Fan Speed Status (Each Fan Coil)	AI	Through network	1 min	15 min	–

3. Heat Pump/Chillers: Not all points available with all manufacturers. Include points listed from each refrigerant circuit.

Description	Type	Device	Trend Logging		Calibra-tion
			Comm-issioning	Contin-uous	
Evap. outlet temperature	AI	Through network	10 min.	10 min.	F
Evap. inlet temperature	AI	Through network	10 min.	10 min.	F
Common Evap. outlet temperature	AI	Through network	10 min.	10 min.	F
Common Evap. inlet temperature	AI	Through network	10 min.	10 min.	F
Recovery outlet temperature	AI	Through network	10 min.	10 min.	F
Recovery inlet temperature	AI	Through network	10 min.	10 min.	F
External air temperature	AI	Through network	10 min.	10 min.	F
Refrigerant gas temperature	AI	Through network	10 min.	10 min.	F
Refrigerant liquid temperature	AI	Through network	10 min.	10 min.	F
System dead zone	AO	Through network	10 min.	10 min.	F
Recovery dead zone	AO	Through network	10 min.	10 min.	
Defrost current Delta LP	AI	Through network	10 min.	10 min.	F
Auto. Differential HP only	AO	Through network	10 min.	10 min.	
Auto. Differential chiller only	AO	Through network	10 min.	10 min.	
Current system setpoint	AI	Through network	10 min.	10 min.	

Description	Type	Device	Trend Logging		Calibra-tion
			Comm-issioning	Contin-uous	
Total recovery set-point	AO	Through network	10 min.	10 min.	
Total recovery differential	AO	Through network	10 min.	10 min.	
System summer differential	AO	Through network	10 min.	10 min.	
System winter differential	AO	Through network	10 min.	10 min.	
Setpoint summer	AO	Through network	10 min.	10 min.	
Setpoint winter	AO	Through network	10 min.	10 min.	
System On/Off Mode	AO	Through network	10 min.	10 min.	
Recovery On/Off Mode	AO	Through network	10 min.	10 min.	
Summer winter selection	AO	Through network	10 min.	10 min.	
Mode duration minimum time	AO	Through network	10 min.	10 min.	
System active power	AI	Through network	10 min.	10 min.	F
Recovery active power	AI	Through network	10 min.	10 min.	F
Unit state	AI	Through network	10 min.	10 min.	
Total power request	AI	Through network	10 min.	10 min.	
Fan speed	AI	Through network	10 min.	10 min.	
Total power request	AI	Through network	10 min.	10 min.	
defrost State	AI	Through network	10 min.	10 min.	
Unit On/Off	DI	Through network	COV	COV	
Summer/Winter request	DO	Through network	COV	COV	
Reset alarms	DO	Through network	COV	COV	
System On/Off	DO	Through network	COV	COV	
Recovery On/Off	DO	Through network	COV	COV	
Evaporative pump status	DI	Through network	COV	COV	
Recovery pump status	DI	Through network	COV	COV	
Compressor status	DI	Through network	COV	COV	
Fan status	DI	Through network	COV	COV	
Reversing valve	DI	Through network	COV	COV	
Defrost valve	DI	Through network	COV	COV	
All alarms	DI	Through network	COV	COV	

4. Electrical Power Monitor (PM)

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
kW	AI	Through network	15 min	15 min	–
Volts (each phase)	AI	Through network	±10%	±10%	–
Power factor	AI	Through network	±10%	±10%	–
Amps (each phase)	AI	Through network	–	–	–

5. Automated Demand Response

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Demand Response Level	AI	Level 1, 2, or 3 from OpenADR Virtual End Node	±1	±1	–
Minutes until next occurrence of Demand Level 1	AI	From OpenADR Virtual End Node	±1 min	±1 min	–
Minutes until next occurrence of Demand Level 2	AI	From OpenADR Virtual End Node	±1 min	±1 min	–
Minutes until next occurrence of Demand Level 3	AI	From OpenADR Virtual End Node	±1 min	±1 min	–

6. Lighting Controls

a. Global

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Demand Shed 1	DO	Through network	COV	COV	–
Demand Shed 2	DO	Through network	COV	COV	–
Demand Shed 3	DO	Through network	COV	COV	–

b. For each lighting zone

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Occupancy Sensor State	DI	Through network	COV	COV	–

7. Emergency Generator

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Status normal power	DI	Through network	COV	COV	–
Status generator power	DI	Through network	COV	COV	–
Generator running	DI	Through network	COV	COV	–
Generator not in auto	DI	Through network	COV	COV	–
Shut-down summary alarm	DI	Through network	COV	COV	–
Fuel tank alarm – low level	DI	Through network	COV	COV	–
Fuel tank alarm – high level	DI	Through network	COV	COV	–
Fuel tank alarm – rupture	DI	Through network	COV	COV	–
Water temperature alarm	DI	Through network	COV	COV	–
Low DC battery voltage	DI	Through network	COV	COV	–
Battery charger malfunction	DI	Through network	COV	COV	–
Ground fault	DI	Through network	COV	COV	–
Low coolant level	DI	Through network	COV	COV	–
Pre-alarm Low fuel	DI	Through network	COV	COV	–
Pre-alarm high water temperature	DI	Through network	COV	COV	–
Pre-alarm low oil pressure	DI	Through network	COV	COV	–
Over-speed alarm	DI	Through network	COV	COV	–
Over-crank alarm	DI	Through network	COV	COV	–
High water temperature alarm	DI	Through network	COV	COV	–
Low oil pressure alarm	DI	Through network	COV	COV	–
Emergency stop alarm	DI	Through network	COV	COV	–
Pre-overload alarm	DI	Through network	COV	COV	–
Overload alarm	DI	Through network	COV	COV	–
AC current Phase 1	AI	Through network	±10%	±10%	–
AC current Phase 2	AI	Through network	±10%	±10%	–
AC current Phase 3	AI	Through network	±10%	±10%	–
AC voltage neutral	AI	Through network	±10%	±10%	–
AC voltage Phase 1	AI	Through network	±10%	±10%	–
AC voltage Phase 2	AI	Through network	±10%	±10%	–
AC voltage Phase 3	AI	Through network	±10%	±10%	–

8. DCW Booster Pump

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Pump 1 status	DI	Through network	COV	COV	–
Pump 2 status	DI	Through network	COV	COV	–
Alarm	DI	Through network	COV	COV	–
Unit failure/trouble alarm	DI	Through network	COV	COV	–
Communications alarm	DI	Through network	COV	COV	–
Pump 1 speed	AI	Through network	1 min	15 min	–
Pump 2 speed	AI	Through network	1 min	15 min	–
Pump 1 VFD kW	AI	Through network	1 min	15 min	–
Pump 2 VFD kW	AI	Through network	1 min	15 min	–
Difference pressure	AI	Through network	1 min	15 min	–
Difference pressure setpoint	AO	Through network	1 min	15 min	–

D. Hardwired Points

1. VAV Dual Duct Zones

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Cooling damper	AO (or two DOs and an AI)	Modulating (or floating with position feedback) actuator	COV	COV	–
Heating damper	AO (or two DOs and an AI)	Modulating (or floating with position feedback) actuator	COV	COV	–
Local Override	DI	TS-3x – where applicable (see Paragraph 2.9F).	COV	COV	–
Zone Temperature Setpoint Adjustment	AI	TS-3x – where applicable (see Paragraph 2.9F).	15 min	60 min	F
Zone Temperature	AI	TS-3x (see Paragraph 2.9F)	1 min	15 min	F
Cooling air volume	AI	DPT-5 connected to box manufacturer supplied flow cross at cooling inlet	1 min.	10 min.	HH (see §230593)

Description	Type	Device	Trend Logging		Calibra-tion
			Comm-issioning	Contin-uous	
Heating air volume	AI	DPT-5 connected to box manufacturer supplied flow cross at heating inlet	1 min.	10 min.	HH (see §23059 3)
CO_2 concentration	AI	TS-3x (see Paragraph 2.9F)	1 min.	10 min.	F

2. 2-Pipe Air-Source Heat Pump/Chiller Plant

Description	Type	Device	Trend Logging		Calibra-tion
			Comm-issioning	Contin-uous	
HP-1 on/off	DO	Connect to 2-pipe HP/chiller enable contact on chiller panel	COV	COV	–
HP-1 mode	DO	Connect to 2-pipe HP/chiller heat/cool mode contact on chiller panel	COV	COV	–
HP-2 on/off	DO	Connect to 2-pipe HP/chiller enable contact on chiller panel	COV	COV	–
HP-2 mode	DO	Connect to 2-pipe HP/chiller heat/cool mode contact on chiller panel	COV	COV	–
HPCH-1 changeover valves	DO	2-position 2-way valves, line size, spring return	COV	COV	–
HPCH-2 changeover valves	DO	2-position 2-way valves, line size, spring return	COV	COV	–
HW supply flow	AI	FM-1	5 min	15 min	F
CHW supply flow	AI	FM-1	5 min	15 min	F
HW supply temperature	AI	TS-2B	5 min	15 min	HH
HW return temperature	AI	TS-2B	5 min	15 min	HH
CHW supply temperature	AI	TS-2B	5 min	15 min	HH
CHW return temperature	AI	TS-2B	5 min	15 min	HH
HW system gauge pressure	AI	PT-1, 0 to 60 psi (located near expansion tank)	15 min	1 hr	F
CHW system gauge pressure	AI	PT-1, 0 to 60 psi (located near expansion tank)	15 min	1 hr	F

3. DFDD VAV Air Handler

Description	Type	Device	Trend Logging		Calibra-tion
			Comm-issioning	Contin-uous	
Relief Damper Open/Close	DO	Connect to actuator provided with AHU.	COV	COV	–
Relief Fan Start/Stop	DO	Connect to VFD Run	COV	COV	–
Cooling Fan Start/Stop	DO	Connect to VFD Run	COV	COV	–
Cooling Supply fan high static alarm reset	DO	Dry contact to 120V or 24V control circuit	COV	COV	–
Heating Supply fan high static alarm reset	DO	Dry contact to 120V or 24V control circuit	COV	COV	–
Heating Fan Start/Stop	DO	Connect to VFD Run	COV	COV	–
Relief Fan Speed	AO	Connect to VFD Speed	1 min	15 min	–
Outdoor Air Damper	AO	Modulating actuator	1 min	15 min	–
Return Air Damper	AO	Modulating actuator	1 min	15 min	–
Cooling Fan Speed	AO	Connect to VFD Speed	1 min	15 min	–
Hot Deck Heating Coil Hot Water Valve	AO	3-way valve	1 min	15 min	–
Cold Deck Changeover Coil Control Valve	AO	3-way valve	1 min	15 min	–
Cold Deck Changeover Coil Changeover Switch	DO	2-way, 2-position valve	COV	COV	–
Heating Fan Speed	AO	Connect to VFD Speed	1 min	15 min	–
Building Static Pressure	AI	DPT-4, ±0.25 inches with ceiling probe sensor on L2	5 min	15 min	F
Outdoor Air Temperature	AI	Provided with AHU.	5 min	15 min	HH
Outdoor Airflow	AI	Provided with AHU.	5 min	15 min	F
Mixed Air Temperature	AI	TS-1B across filter bank	1 min	15 min	F
Cold-Duct Filter Pressure Drop	AI	DPT-3A, 0 to 1 inches	–	60 min	F
Return Air Temperature	AI	TS-1A	1 min	15 min	F
Cold-Duct Supply Air Temperature	AI	TS-1A	1 min	15 min	HH
Cold-Duct Static Pressure	AI	DPT-3, 0 to 2 inches	1 min	15 min	F
Hot-Duct Filter Pressure Drop	AI	DPT-3A, 0 to 1 inches	–	60 min	F
Hot-Duct Supply Air Temperature	AI	TS-1A	1 min	15 min	HH
Hot-Duct Static Pressure	AI	DPT-3, 0 to 2 inches	1 min	15 min	F

4. Domestic Water Heaters

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
DHW System Re-Circulation Pump Start/Stop	DO	Line voltage contact to pump power circuit	COV	COV	–
DHW Supply Temperature	AI	TS-2A	5 min	15 min	F
DHW System Re-Circulation Pump Status	DI	CS-1 OR CT-1	COV	COV	See 3.12F
EWH-1 heater Alarm	DI	Install relay wired downstream of DHW heater safeties with NC relay contact wired as alarm input.	COV	COV	–

5. Transfer Fans

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Zone Temperature Monitoring	AI	TS-3A	1 min	15 min	F

6. Constant Volume ECM Exhaust Fans

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Fan Start/Stop	DO	Dry contact to EC controller	COV	COV	–
Fan Status	DI	CS-1 OR CT-1 (or EC controller if available)	COV	COV	See 3.12F

7. Miscellaneous Points

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Outdoor Air Temperature	AI	TS-4, located on roof	1 min	15 min	HH

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.

B. Coordinate Work and Work schedule with other trades prior to construction.

C. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment.

B. Store equipment and materials inside and protect from weather.

3.3 IDENTIFICATION

A. General

1. Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.

2. Identifiers shall match record documents.

3. All plug-in components shall be labeled such that removal of the component does not remove the label.

B. Wiring and Tubing

1. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2 inches of termination with the BAS address or termination number.

2. Permanently label or code each point of field terminal strips to show the instrument or item served.

3. All pneumatic tubing shall be labeled at each end within 2 inches of termination with a descriptive identifier.

C. Equipment and Devices

1. Valve and damper actuators: None required.

2. Sensors: Provide 1 inch x 3 inches x 1/8 inches black micarta or lamacoid labels with engraved white lettering, ¼ inches high. Indicate sensor identifier and function (for example “CHWS Temp”).

3. Panels

   a. Provide 2 inches x 5 inches 1/8 inches black micarta or lamacoid labels with engraved white lettering, ½ inches high. Indicate panel identifier and service.

   b. Provide permanent tag indicating the electrical panel and circuit number from which panel is powered.

4. Identify room sensors relating to terminal box or valves with indelible marker on sensor hidden by cover.

3.4 CUTTING, CORING, PATCHING AND PAINTING

A. Provide canning for openings in concrete walls and floors and other structural elements prior to their construction.

B. Penetrations through rated walls or floors shall be filled with a listed material to provide a code compliant fire-stop.

C. 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 mechanics 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.

D. 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.

3.5 CLEANING

A. 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 legally disposed of.

B. 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 College’s Representative.

C. At the completion of work in any area, clean all work and equipment of dust, dirt, and debris.

D. Use only cleaning materials recommended by the manufacturer of the surfaces to be cleaned and on surfaces recommended by the cleaning material manufacturer.

3.6 CONTROLLERS

A. General

1. Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details indicated on Drawings.

2. Regardless of application category listed below, each Control Unit shall be capable of performing the specified sequence of operation for the associated equipment. Except as listed below, all physical point data and calculated values required to accomplish the sequence of operation shall reside within the associated CU. Listed below are point data and calculated values that shall be allowed to be obtained from other CUs via LAN.

   a. Global points such as outdoor air temperature

   b. Requests, such as heat/cool requests, used to request operation or for setpoint reset from zones to systems and systems to plants

   c. Modes, such as system modes, used to change operating logic from plants to systems and systems to zones

3. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

B. Controller Application Categories

1. Controllers shall comply with the application table below (X under controller type indicates acceptable controller type).

Application Category	**Examples**	**Acceptable Controller**		
		ASC	**AAC**	**BC**
0	Monitoring of variables that are not used in a control loop, sequence logic, or safety, such as status of sump pumps or associated float switches, temperatures in monitored electrical rooms.	X	X	X
1	Miscellaneous heaters Constant speed exhaust fans and pumps	X	X	X
2	Terminal Units (such as VAV Boxes)	X		
4	Air Handling Units Heat Pump Water Plant		X (note 1)	X
Notes: Controller may be used only if all control functions and physical I/O associated with a given unit resides in one AAC/ASC				

2. ASC Installation

    a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use if ceiling attic is used as a return air plenum.

    b. ASCs that control equipment mounted in a mechanical room may either be mounted in or on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.

    c. ASCs that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.

3. AAC and BC Installation

    a. AACs/BCs shall be located in a temperature control cabinets constructed per Paragraph 2.8.

3.7 COMMUNICATION DEVICES

A. General

1. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.

2. Provide all interface devices and software to provide an integrated system.

B. LANID and LAN Routers

1. Provide as required

2. Connect networks to both sides of device

3. Thoroughly test to ensure proper operation

4. Interruptions or fault at any point on any Primary LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted. 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. Gateways and Protocol Translators to Equipment Controllers

1. See Paragraph 2.4E for network connection of Gateways and Protocol Translators.

2. Wire to networks on both sides of device.

3. Map across all monitoring and control points listed in Paragraph 2.12C.

4. Thoroughly test each point to ensure that mapping is accurate.

5. Initiate trends of points as indication in Paragraph 2.12C.

D. External Communications

1. Provide an Ethernet second port on the CSS to which the College can connect their College IT LAN, by others. Contractor shall coordinate with the College's Representative to establish an IP address and communications parameters to assure proper operation. This connection shall also provide access to Internet through College's firewall to Internet Services Provider procured by College.

3.8 BAS INTERFACE HARDWARE

A. Provide the following BAS Interface Hardware:

Device	Quantity
Control System Server	1
Operator Workstation	0
Portable Operator's Terminal	0
Uninterruptible Power Supply	0
Color Inkjet Printer	0
Alarm Dot Matrix Printer	0

B. Install all hardware and software and configure all devices in accordance with manufacturer's instructions.

C. Provide all licenses, keys, etc. and all documentation and any information required to install, configure, operate, diagnose and maintain the system.

D. Connections

1. CSS

a. Connect to Supervisory LAN

b. Connect to College IT LAN.

E. Backup

1. After completion and acceptance of installation, create a backup of all OWSs and server database and configuration files for permanent record of initial installation on a flash drive. Make three copies, two for College and one for Contractor to retain for his records off-site.

2. All other backup configuration shall be by the College.

F. Anti-virus and firewall software and installation shall be by the College.

3.9 CONTROL AIR TUBING

A. Sensor air tubing shall be sized by the Contractor.

B. All control air piping shall be concealed except in equipment rooms or unfinished areas.

C. Installation methods and materials

1. Concealed and Inaccessible: Use copper tubing or FR plastic in metal raceway. Exception: Room thermostat drops in stud walls in areas with lay-in ceiling may be FR plastic tubing.

2. Concealed and Accessible tubing (including ceiling return air plenums) shall be copper tubing or FR plastic tubing, subject to the following limitations

a. FR tubing shall be enclosed in metal raceway when required by local code.

b. Quantity of FR tubing per cubic foot of plenum space shall not exceed manufacturer's published data for Class 1 installation.

3. Exposed to view or damage: Use hard-drawn copper or FR plastic in metal raceway.

a. Where copper tubing is used, a section 12 inches or less of FR plastic tubing is acceptable at final connection to control device.

D. Mechanically attach tubing to supporting surfaces. Sleeve through concrete surfaces in minimum 1 inch sleeves, extended 6 inches above floors and 1 inch below bottom surface of slabs.

E. Pneumatic tubing shall not be run in raceway containing electrical wiring.

F. Where FR tubing exits the end of raceway or junction box, provide a snap-in nylon bushing. Where pneumatic tubing exits control panels, provide bulkhead fittings. Where copper tubing exits junction boxes or panels, provide bulkhead fittings.

G. All tubing shall be number coded on each end and at each junction for easy identification.

H. All control air piping shall be installed in a neat and workmanlike manner parallel to building lines with adequate support.

I. Piping above suspended ceilings shall be supported from or anchored to structural members or other piping or duct supports. Tubing shall not be supported by or anchored to electrical raceways or ceiling support systems.

J. Brass-barbed fittings shall be used at copper-to-FR tubing junctions. Plastic slipped-over copper tubing is not acceptable.

K. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.

3.10 CONTROL POWER

A. Power wiring and wiring connections required for Work in this Section shall be provided under this Section unless specifically indicated on Division 26 Drawings or Specifications. See Paragraph 1.1B.

B. Extend power to all BAS devices, including 120V power to panels, from an acceptable power panel.

1. See Division 26 Electrical Drawings for power locations pre-allocated for BAS system.

2. Where no power source is indicated on drawings, for bid purposes only, assume a dedicated circuit is available within an average of 20 feet of panel location. If this is not the case, request additional cost prior to submission of shop drawings or no additional costs will be reimbursed.

3. Coordinate with Division 26 during shop drawing development for final connection location.

C. 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 equipment is located inside a new equipment enclosure, 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. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, or interruptible), the controller, and any associated switches

and devices necessary its operation, shall be powered by the highest level of reliability served.

D. Unless transformers are provided with equipment as specified in related Division 23 and 26 equipment Sections, Contractor shall provide transformers for all low voltage control devices including non-powered terminal units such as cooling-only VAV boxes and VAV boxes with hot water reheat. Transformer(s) shall be located in control panels in readily accessible locations such as Electrical Rooms.

E. Power line filtering. Provide transient voltage and surge suppression for all workstations and BCs either internally or as an external component.

3.11 CONTROL AND COMMUNICATION WIRING

A. Control and Signal Wiring

1. Comply with Division 26.

2. Line Voltage Wiring

a. All line-voltage wiring shall meet NEC Class 1 requirements.

b. All Class 1 wiring shall be installed in UL Listed approved raceway per NEC requirements and shall be installed by a licensed electrician.

c. Class 1 wiring shall not be installed in raceway containing pneumatic tubing.

3. Low Voltage Wiring

a. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

b. Class 2 wiring shall be installed in UL Listed approved raceway as follows:

1) Where located in unconcealed or inaccessible locations, such as:

a) Equipment rooms

b) Exposed to weather

c) Exposed to occupant view

d) Inaccessible locations such as concealed shafts and above inaccessible ceilings

2) Class 2 wiring shall not be installed in raceway containing Class 1 wiring.

c. Class 2 wiring need not be installed in raceway as follows:

1) Where located in concealed and easily accessible locations, such as:

   a) Inside mechanical equipment enclosures and control panels

   b) Above suspended accessible ceilings (e.g. lay-in and spline)

   c) Above suspended drywall ceilings within reach of access panels throughout

   d) In shafts within reach of access panels throughout

   e) Nonrated wall cavities

2) Wiring shall be UL Listed for the intended application. For example, cables used in floor or ceiling plenums used for air transport shall be UL Listed specifically for that purpose.

3) Wiring shall be supported from or anchored to structural members neatly tied at 10 foot intervals and at least 1 foot above ceiling tiles and light fixtures. Support or anchoring from straps or rods that support ductwork or piping is also acceptable. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceilings.

4) Install wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

d. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two (for example relays and transformers).

4. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

5. All field wiring shall be properly labeled at each end, with self-laminating typed labels indicating device address, for easy reference to the identification schematic. All power wiring shall be neatly labeled to indicate service, voltage, and breaker source.

6. Use coded conductors throughout with different colored conductors.

7. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

8. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the Contractor shall provide step-down transformers.

9. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

10. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements.

11. Include one pull string in each raceway 1 inch or larger.

12. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

13. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (for example steam pipes or flues).

14. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

15. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

16. Terminate all control or interlock wiring.

17. Maintain updated as-built wiring diagrams with terminations identified at the jobsite.

18. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than ½ inches electrical trade size shall not be used. In areas exposed to moisture liquid-tight, flexible metal raceways shall be used.

19. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings per code. Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.

20. Wire digital outputs to either the normally-closed or normally-open contacts of binary output depending on desired action in case of system failure. Unless otherwise indicated herein, wire to the NO contact

21. Hardwire Interlocks

    a. The devices referenced in this Section are hardwire interlocked to ensure equipment shutdown occurs even if control systems are down. Do not use software (alone) for these interlocks.

    b. Hardwire device NC contact to air handler fan starter upstream of HOA switch, or to VFD enable contact.

c. Where multiple fans (or BAS DI) are controlled off of one device and the device does not have sufficient contacts, provide a relay at the device to provide the required number of contacts.

d. Provide for the following devices where indicated on Drawings or in Sequences of Operation:

1) Duct smoke detector

2) High discharge static pressure

3) Low mixing plenum pressure

22. Shielded cable shield shall be grounded only at one end. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

B. Communication Wiring

1. Adhere to the requirements of Paragraph 3.11A in addition to this Paragraph.

2. Communication and signal wiring may be run without conduit in concealed, accessible locations as permitted by Paragraph 3.11A only if noise immunity is ensured. Contractor is fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.

3. All cabling shall be installed in a neat and workmanlike manner. Follow all manufacturers' installation recommendations for all communication cabling.

4. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

5. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.

6. Verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

7. All runs of communication wiring shall be unspliced length when that length is commercially available.

8. All communication wiring shall be labeled to indicate origination and destination data.

9. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding.

10. Power-line carrier signal communication or transmission is not acceptable.

3.12 SENSORS AND MISCELLANEOUS FIELD DEVICES

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Sensors used as controlled points in control loops shall be hardwired to the controller to which the controlled device is wired and in which the control loop shall reside.

D. Temperature Sensors

1. Room temperature sensors and thermostats shall be installed with back plate firmly secured to the wall framing or drywall anchors.

   a. For sensors mounted in exterior walls or columns, use a back plate insulated with foam and seal all junction box openings with mastic sealant.

   b. For sensors on exposed columns, use Wiremold or equal enclosures that are the smallest required to enclose wiring (e.g. Wiremold 400 BAC or equal) and Wiremold or equal junction boxes that are the narrowest required to enclose the temperature sensor and wiring connections (e.g. Wiremold 2348S/51 or equal). Color or raceway and boxes shall be per the architect; submit for approval prior to installation.

2. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

3. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip. Where located in front of filters (such as mixed air sensors), access for filter removal shall be maintained.

4. Temperature sensors downstream of coils shall be located as far from the coil fins as possible, 6 inches minimum. Temperature sensors upstream of coils shall be a minimum of 6 inches away from the coil fins. No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements. Discharge temperature sensors on VAV boxes shall be mounted as far from the coil as possible but upstream of the first diffuser with the probe located as near as possible to the center of the duct both vertically and horizontally.

5. All pipe-mounted temperature sensors shall be installed in wells. For small piping, well shall be installed in an elbow into pipe length. Install the sensor in the well with a thermal-conducting grease or mastic. Use a closed-cell insulation patch that is integrated into the pipe insulation system to isolate the top of the well from ambient conditions but allow easy access to the sensor. Install a test plug adjacent to all wells for testing and calibration.

6. Unless otherwise noted on Drawings or Points List, temperature sensors/thermostats, humidity sensors/humidistats, CO_2 sensors, and other room 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. Unless otherwise noted on Drawings or Points List, install outdoor air temperature sensors on north wall where they will not be influenced by building exhaust, exfiltration, or solar insolation. Do not install near intake or exhaust air louvers.

E. Differential Pressure Sensors

1. Supply Duct Static Pressure

a. Mount transmitter in temperature control panel near or in BAS panel to which it is wired.

b. Low pressure port of the pressure sensor

1) Pipe to either

a) Building pressure (high) signal of the building static pressure transmitter.

b) Open to a conditioned space inside the building

c) Open to the BAS panel in which the DPT is mounted provided the panel is inside the building envelope and not in an air plenum.

c. High-pressure port of the pressure sensor

1) Pipe to the duct using a static pressure tip located as indicated on Drawings; if no location is indicated, locate at end of duct riser or main as far out in the system as possible but upstream of all smoke and fire dampers.

2) Install pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions.

2. Return Fan Discharge Plenum Pressure

a. Mount transmitter in temperature control panel near or in BAS panel to which it is wired.

b. Low pressure port of the pressure sensor

1) Pipe to either

a) Building pressure (low) signal of the building static pressure transmitter.

b) Separate ambient static pressure probe located on the outside of the relief damper through a high-volume accumulator or otherwise protected from wind fluctuations.

c. High-pressure port of the pressure sensor

1) Pipe to the duct using a static pressure tip located at the discharge of the return fan.

2) Install pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions.

3. Building Static Pressure

a. Mount transmitter in temperature control panel near or in BAS panel to which it is wired.

b. Low pressure port of the pressure sensor

1) Pipe to the ambient static pressure probe located on the outside and at high point of the building through a high-volume accumulator or otherwise protected from wind fluctuations.

c. High-pressure port of the pressure sensor

1) Pipe to either

a) Behind a BAS temperature sensor cover in an interior zone (provided sensor has openings to allow ambient air to freely flow through it)

b) Wall plate sensor or wall/ceiling probe sensor as scheduled

2) Do not locate near elevators, exterior doors, atria, or (for ceiling sensor applications) near diffusers.

4. Filter Differential Pressure

a. Install static-pressure tips upstream and downstream of filters with tips oriented in direction of flow. If there is a Magnehelic gauge installed by the AHU manufacturer, it may be removed and discarded with its pressure tips used for the DPT provided the DPT has an LCD so it can double as a visual gauge.

b. Mount transmitter on outside of filter housing or filter plenum in an accessible position with LCD display clearly visible. This sensor is used in lieu of an analog gauge and thus must be readily viewable.

5. Minimum Outdoor Air Damper Differential Pressure

    a. Install plenum static-pressure sensors upstream and downstream of minimum outdoor air damper in a location where air velocity is minimal.

    b. Mount transmitter on inside or outside of economizer plenum (whichever is most accessible while out of weather) in an accessible position with LCD display clearly visible.

6. High/Low Static Pressure Safeties

    a. High static

        1) Install DPS-2 on side of supply air duct in accessible location.

        2) High port shall be open to supply air duct downstream of fan.

        3) Reference low port pressure shall be that at DP location.

    b. Low static

        1) Install DPS-2 inside or outside of mixed air plenum whichever is most accessible.

        2) Low port shall be open to mixed air plenum.

        3) Reference high port pressure shall be pressure on other side of mixed air plenum with the highest pressure, e.g. ambient pressure for systems with relief fans or non-powered relief, or relief air plenum for systems with return fans.

7. All pressure transducers, other than those controlling VAV boxes, shall be located where accessible for service without use of ladders or special equipment. If required, locate in field device panels and pipe to the equipment monitored or ductwork.

8. The piping to the pressure ports on all pressure transducers (both air and water) shall contain a capped test port located adjacent to the transducer.

9. Piping differential pressure transducers shall have one of the following:

    a. Five valve manifold, brass, two valves to allow removal of sensor without disrupting the hydronic system, an equalizing valve to allow the sensor to be zeroed and to prevent sensor from experiencing full static (as opposed to differential), and two valves used as air vents that also can be used as test plugs for calibration.

    b. For sensors using two separate sensors, install test plugs on each connection for calibration and also used as vents.

F. Current Switches and Current Transformers for Motor Status Monitoring

1. For CTs, create a software binary point for fan status triggered at a setpoint determined below and ~10% deadband.

2. Adjust the setpoint so that it is below minimum operating current and above motor no load current. For fans with motorized discharge dampers, adjust so that fan indicates off if damper is closed while fan is running. For pumps, adjust so that pump indicates off if valve is closed while pump is running.

G. Airflow Measuring Stations: Install per manufacturer's recommendations for unobstructed straight length of duct both upstream and downstream of sensor, except those installations specifically designed for installation in fan inlet. For installations in fan inlets, provide on both inlets of double inlet fans and provide inlet cone adapter as recommended by AFMS manufacturer.

H. Fluid Flow Meters: Install per manufacturer's recommendations for unobstructed straight length of pipe both upstream and downstream of sensor. Commission per the manufacturer's startup and commissioning recommendations. Complete all manufacturer's startup documentation and include this in prefunctional commissioning report.

I. Window Switches

1. Wiring

a. All wiring concealed in mullions and wall cavity to the extent possible. Review wiring routing details in mullions with window manufacturer.

b. Wiring that cannot be enclosed in mullions and walls shall be installed in Wiremold; location shall be reviewed and approved by College prior to installation.

2. Where there is more than one switch in a zone, wire in series so that windows are indicated as open when any window is open and indicated as closed when all are closed.

J. Actuators

1. Type: All actuators shall be electric.

2. Mount and link control damper actuators per manufacturer's instructions.

3. Dampers

a. To compress seals when spring-return actuators are used on normally closed dampers, 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.

b. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

c. Provide all mounting hardware and linkages for actuator installation.

4. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, mount the valve so that the position indicator is visible from the floor or other readily accessible location. However, do not install valves with stem below horizontal or down. The preferred location for the valve and actuator is on lowest point in the valve train assembly for ease of access and inspection. If this is on the coil supply piping, the control valve may be located there even if schematics (and standard practice) show valves located on the coil return piping. This comment applies to both 2−way valves and 3-way valves (which would become diverting valves rather than mixing valves in this location).

3.13 SOFTWARE INSTALLATION

A. System Configuration

1. Thoroughly and completely configure BAS system software, supplemental software, network software etc. on OWS, POTs, and servers.

B. Point Structuring and Naming

1. The intent of this Paragraph is to require a consistent means of naming points across the BAS. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, etc.

2. Point Summary Table

a. The term “Point” includes all physical I/O points, virtual points, and all application program parameters.

b. With each schematic, provide a Point Summary Table listing

1) Building number and abbreviation

2) System type

3) Equipment type

4) Point suffix

5) Full point name (see Point Naming Convention Paragraph)

6) Point description

7) Ethernet backbone network number

8) Network number

9) Device ID

10) Device MAC address

11) Object ID (object type, instance number)

12) Engineering units

13) Device make and model number; include range of device if model number does not so identify.

14) Device physical location description; include floor and column line intersection to one decimal place (for example line 6.2 and line A.3).

c. Point Summary Table shall be provided in both hard copy and in a relational database electronic format (ODBC-compliant).

d. Coordinate with the College's representative and compile and submit a proposed Point Summary Table for review prior to any object programming or Project startup.

e. The Point Summary Table shall be kept current throughout the duration of the Project by the Contractor as the Master List of all points for the Project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the College the final Point Summary Table prior to final acceptance of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.

3. Point Naming Convention

a. All point names shall adhere to the format as established below, unless otherwise agreed to by the College. New categories and descriptors may be created with approval of the College.

b. Format:

1) Building.Category.System.EquipmentTag.Component.Property.

2) Example: 001.HVAC.Heatplant.B-1.HWS.Temperature

Building	Category	System	Equipment Tag	Component	Property	Typical units
Building number	ELCT	Lighting Plug Generator Misc	(from equipment schedules)	SWITCH PHOTO CB CWS CWR HWS HWR CHWS CHWR OA SA RA EA GAS FLUID	Command Status Light Power Voltage Current ValvePos DamperPos Temperature Humidity Pressure Flow Energy Speed Signal	On/off On/off Footcandles Watts Volts Amps %open %open °F %RH Psig, “H_2O Cfm, gpm Btu %, Hz %
	HVAC	Airhandling Exhaust Heatplant Coolplant Misc				
	PLMB	Domwater Air Natgas N2 O2 Irrigation Waste Misc				
	MISC	Weather				

4. Device Addressing Convention

   a. BACnet network numbers and Device Object IDs shall be unique throughout the network.

   b. All assignment of network numbers and Device Object IDs shall be coordinated with the College to ensure there are no duplicate BACnet device instance numbers.

   c. Each Network number shall be unique throughout all facilities and shall be assigned in the following manner: VVVNN, where: VVV = 0-999 for BACnet Vendor ID, NN = 00 - 99 for building network.

   d. Each Device Object Identifier property shall be unique throughout the system and shall be assigned in the following manner: VVVNNDD , where: VVV = number 0 to 999 for BACnet Vendor ID , NN = 00 - 99 for building network, DD = 01-99 for device address on a network.

   e. Coordinate with the College or a designated representative to ensure that no duplicate Device Object IDs occur.

   f. Alternative Device ID schemes or cross-project Device ID duplication if allowed shall be approved before Project commencement by the College.

5. I/O Point Physical Description

a. Each point associated with a hardware device shall have its BACnet long-name point description field filled out with:

1) The device manufacturer and model number. Include range of device if model number does not so identify.

2) For space sensors, include room number in which sensor is located.

C. Point Parameters

1. Provide the following minimum programming for each analog input

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 value reporting limits (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. This is required only for points that are transferred across the Primary or Secondary networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides or failure of any network over which the point value is transferred.

2. Provide the following minimum programming for each analog output

a. Name

b. Address

c. Engineering units

d. Offset calibration and scaling factor for engineering units

e. Output Range

f. Default value to be used when the normal controlling value is not reporting.

3. Provide the following minimum programming for each digital input

a. Name

b. Address

c. Engineering units (on/off, open/closed, freeze/normal, etc.)

d. Debounce time delay

e. Message and alarm reporting as specified

f. Reporting of each change of state, and memory storage of the time of the last change of state

g. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

4. Provide the following minimum programming for each digital output

a. Name

b. Address

c. Output updating frequency

d. Engineering units (on/off, open/closed, freeze/normal, etc.)

e. Direct or Reverse action selection

f. Minimum on-time

g. Minimum off-time

h. Status association with a DI and failure alarming (as applicable)

i. Reporting of each change of state, and memory storage of the time of the last change of state.

j. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

k. Default value to be used when the normal controlling value is not reporting.

D. Site-Specific Application Programming

1. All site specific application programming shall be written in a manner that will ensure programming quality and uniformity. Contractor shall ensure:

a. Programs are developed by one programmer, or a small group of programmers with rigid programming standards, to ensure a uniform style.

b. Programs for like functions are identical, to reduce debugging time and to ease maintainability.

c. Programs are thoroughly debugged before they are installed in the field.

2. Massage and tune application programming for a fully functioning system. It is the Contractor's responsibility to request clarification on sequences of operation that require such clarification.

3. All site-specific programming shall be fully documented and submitted for review and approval

   a. Prior to downloading into the panel (see Submittal Package 2, Paragraph 1.6.)

   b. At the completion of functional performance testing, and

   c. At the end of the warranty period (see Warranty Maintenance, Paragraph 1.11).

4. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the Project will be the property of the College and shall remain on the workstations/servers at the completion of the Project.

E. Graphic Screens

1. All site specific graphics shall be developed in a manner that will ensure graphic display quality and uniformity among the various systems.

2. Schematics of MEP systems

   a. Schematics shall be 2-D or 3-D and shall be based substantially on the schematics provided on Drawings.

   b. All relevant I/O points and setpoints being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse.

   c. Animation or equipment graphic color changes shall be used to indicate on/off status of mechanical components.

   d. Indicate all adjustable setpoints and setpoint high and low limits (for automatically reset setpoints), on the applicable system schematic graphic or, if space does not allow, on a supplemental linked-setpoint screen.

3. Displays shall show all points relevant to the operation of the system, including setpoints.

4. The current value and point name of every I/O point and setpoint shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.

5. Show weather conditions (local building outside air temperature and humidity) in the upper left hand corner of every graphic.

6. CAD Files: The contract document drawings will be made available to the Contractor in AutoCAD format upon request for use in developing backgrounds for specified graphic screens, such as floor plans and schematics. However the College does not guarantee the suitability of these drawings for the Contractor's purpose.

7. Provide graphics for the following as a minimum

    a. Building homepage: Background shall be a building footprint, approximately to scale, oriented as shown on the architectural Drawings. Include links to each floor and mechanical room/area, and to summary graphics described below. Include real-time site utility data such asbuilding electrical demand shown roughly on the map where the utilities connect to the site.

    b. Electricity demand limiting

        1) Demand limit. Include entries for sliding window interval and a table of Off-Peak, On-Peak or Partial-Peak demand time periods, both Summer and non-Summer, with three adjustable demand level limits for each and adjustable deadband.

        2) Electricity demand calculation. For each month, show actual peak kW and kWh for each time-of-day rate period. Show side-by-side as month-this-year and month-last-year, and month-to-date and year-to-date data.

    c. Each occupied floor plan, to scale

        1) HVAC: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective setpoints. The colors shall be updated dynamically as a zone's actual comfort condition changes. In each zone, provide links to associated terminal equipment.

        2) If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.

    d. Each equipment floor/area plan: To scale, with links to graphics of all BAS controlled/monitored equipment.

e. Each air handler and fan-coil: Provide link to associated HW and CHW plants where applicable.

f. Each trim & respond reset: Next to the display of the setpoint that is being reset, include a link to page showing all trim & respond points (see Guideline 36) plus the current number of requests, current setpoint, and status indicator point with values “trimming,” “responding,” or “holding.” Include a graph of the setpoint trend for the last 24 hours. Trim & respond points shall be adjustable from the graphic except for the associated device.

g. Each zone terminal

   1) See Sample Graphics – VAV Reheat Zone

   2) See Sample Graphics – VAV Cooling-Only Zone

   3) Include a non-editable graphic (picture) showing the design airflow setpoints from the design drawings adjacent to the editable airflows setpoints. The intent is that the original setpoints be retained over time despite “temporary” adjustments that may be made over the years.

h. Electrical power monitoring system: Show a schematic of the electrical system based on one-line diagrams with meter current kW reading and month-to-date kWh shown in actual locations. Show side-by-side kWh and peak demand as month-this-year and month-last-year, and month-to-date and year-to-date data. Power flow shall change on the diagram (by changing line color or width) to show which power line is active.

i. Water meters: Show side-by-side gallons and peak demand gpm as month-this-year and month-last-year, and month-to-date and year-to-date data.

j. Summary graphics: Provide a single text-based page (or as few as possible) for each of the following summary screens showing key variables listed in columns for all listed equipment. Include hyperlinks to each zone imbedded in the zone tag:

   1) Air handling units: operating mode; on/off status; supply air temperature; supply air temperature setpoint; fan speed; duct static pressure; duct static pressure setpoint; outdoor air and return air damper position; coil valve positions; etc. (all key operating variables); Cooling CHWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Heating HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier (if HW coil)

   2) Zone Groups

      a) Separate zone terminal summary for each Zone Group.

      b) See Sample Graphics –Zone Group Summary

3) VAV Zone terminal units: operating mode; airflow rate; airflow rate setpoint; zone temperature; active heating setpoint; active cooling setpoint; damper position; supply air temperature (reheat boxes); supply air temperature setpoint (reheat boxes); CO2 concentration and CO2 loop output (where applicable); Fan start/stop command, speed, and status (fan-powered); Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Cooling SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Heating HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier (HW reheat); Heating Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier (dual duct); Heating SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier (dual duct).

4) Electrical meters and switches: Volts, current, kW, switch positions.

k. For all equipment with runtime alarms specified, show on graphic adjacent to equipment the current runtime, alarm setpoint (adjustable), alarm light, date of last runtime counter reset, and alarm reset/acknowledge button which resets the runtime counter.

l. For all equipment with lead/lag or lead/standby operation specified, show on graphic adjacent to equipment the current lead/lag order and manual buttons or switches to allow manual lead switching by the operator per Section 259000 Building Automation Sequences of Operation.

m. For all controlled points used in control loops, show the setpoint adjacent to the current value of the controlled point.

n. All other BAS controlled/monitored equipment.

o. On all system graphics, include a “note” block that allows users to enter comments relevant to system operation.

p. All equipment shall be identified on the graphic screen by the unit tag as scheduled on the drawings.

F. Alarm Configuration

1. Program alarms and alarm levels per Sequence of Operations.

2. Each programmed alarm shall appear on the alarm log screen and shall be resettable or acknowledged from those screens. Equipment failure alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, fan alarm shall be shown on graphic air handling system schematic screen). For all graphic screens, display values that are in a Level 1 or 2 condition in a red color, Level 3 and higher alarm condition in a blue color, and normal (no alarm) condition in a neutral color (black or white).

3. For initial setup, Contractor shall configure alarms as follows:

	Level 1	**Level 2**	**Level 3**	**Level 4**
Criticality	Critical	Not Critical	Not Critical	Not Critical
Acknowledgement	Required	Required	Not Required	Not Required
Acknowledgement of Return to Normal	Not Required	Not Required	Not Required	Not Required
Email to building engineer(s)	Y	Y	Y	N
SMS text to building engineer(s)	Y	Y	N	N
Pop-up dialog box on OWS	Y	Y	N	N
Remove from alarm log	After Acknowledged	After Acknowledged	After 2 weeks	After 2 weeks

3.14 SEQUENCES OF OPERATION

A. See Section 259000 Building Automation Sequences of Operation.

3.15 SYSTEM COMMISSIONING

A. Sequencing. The following list outlines the general sequence of events for submittals and commissioning:

1. Submit Submittal Package 0 (Qualifications) and receive approval.
2. Submit Submittal Package 1 (Hardware and Shop Drawings) and receive approval.
3. Initiate installation of BAS hardware, devices and wiring.
4. Develop point database and application software.
5. Simulate sequencing and debug programming off-line to the extent practical.
6. Submit Submittal Package 2 (Programming and Graphics) and receive approval.
7. Complete installation of BAS hardware, devices and wiring.
8. Install point database and application software in field panels.
9. Submit Submittal Package 3 (Pre-Functional Test Forms) and receive approval.
10. Perform BAS Pre-functional Tests (start up, calibration and tuning) and submit completed forms as Submittal Package 4 (Pre-Functional Test Report) for approval.

11. Receive BAS Pre-functional Test Report approval and approval to schedule Functional Tests.

12. Field test application programs prior to functional testing.

13. Submit Package 5 (Post-Construction Trend Points List) in format specified for review and approval.

14. Receive approval of successful Trend Log configuration, or reconfigure as required.

15. Prepare and initiate commissioning Trend Logs.

16. Perform and record functional tests and submit Submittal Package 6 (Functional Test Report) for approval.

17. Assist in TAB tests and determining setpoints as specified in Section 230593 Testing, Adjusting and Balancing.

18. Assist in Title 24 Acceptance Testing as specified in Section 230800 Mechanical System Commissioning.

19. Submit Package 7 (Training Materials) and receive approval.

20. Receive BAS Functional Test Report approval and approval to schedule Demonstration Tests.

21. Perform Demonstration Tests to Commissioning Provider and College's Representatives and submit Demonstration Test Report.

22. Receive acceptance of Demonstration Tests.

23. Train College personnel on BAS operation and maintenance.

24. Substantial Completion

25. Submit Package 8 (Post-Construction Trend Logs) in format specified for review and approval.

26. Receive approval of successful Trend Log tests, or retest as required.

27. Complete all items in Completion Requirements per Paragraph 1.7B.

28. Provide administration level password access to the College.

29. Final Acceptance

30. Begin Warranty Period.

31. Prepare and initiate continuous Trend Logs per Paragraph 2.12A.4.

32. Update all software as specified.

33. End of Warranty Period

B. Assist Commissioning Provider/Coordinator as specified in Section 019100 Commissioning, including attending commissioning meetings.

C. Coordinate with Work specified in Section 230800 Mechanical Commissioning and Division 26 Electrical Commissioning.

D. Pre-functional tests

1. General

a. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.

b. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.

c. Verify integrity/safety of all electrical connections.

d. Verify that shielded cables are grounded only at one end.

e. Verify that all sensor locations are as indicated on drawings and are away from causes of erratic operation.

2. Test Documentation

a. Prepare forms to document the proper startup of the BAS components.

b. All equipment shall be included on test forms including but not limited to

1) Wiring: End-to-end checkout of all wiring at terminations. Power to all controllers and actuators. Confirmation of emergency power where specified.

2) Digital Outputs: Proper installation, normal position, response to command at CU

3) Digital Inputs: Proper installation, device test, response at CU

4) Analog Outputs: Proper installation of devices, verification of maximum and minimum stroke.

5) Analog Inputs: Proper installation of sensors, calibration

6) Panels: Confirmation of location, power source (electrical circuit used), confirmation of emergency power where specified.

7) Alarms and Safeties: Verification of alarm routing to all specified devices and correct hierarchy. Example: confirm alarm routing to cell phones, email, servers, remote workstations. Confirm that appropriate alarm levels are routed to appropriate devices.

8) Loop Tuning: Document setting of P/I parameters for all loops, chosen setpoints, time delays, loop execution speed.

9) Network Traffic: Document speed of screen generation, alarm and signal propagation in system with all required commissioning trends active.

c. 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.

d. Submit blank forms for approval in Submittal Package 3.

e. Complete work, document results on forms, and submit for approval as Submittal Package 4 (Pre-Functional Test Report).

3. Digital Outputs

a. Verify that all digital output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

4. Digital Inputs

a. Adjust setpoints, where applicable.

1) For current switches used as status on fans, adjust current setpoint so that fan status is OFF when fan discharge damper (if present) is fully closed and when belt is broken (temporarily remove belt).

2) For current switches used as status on pumps, adjust current setpoint so that pump status is OFF when pump is dead-headed (temporarily close discharge valve).

3) For differential pressure sensors on pumps and fans, set so that status is on when pump operating with all valves open (out on its curve).

5. Analog Outputs

a. Verify start and span are correct and control action is correct.

b. Check all control valves and automatic dampers to ensure proper action and closure. Make any necessary adjustments to valve stem and damper blade travel.

c. Check all normal positions of fail-safe actuators.

d. For outputs to reset other manufacturer's devices (for example, chiller setpoint) and for feedback from them, calibrate ranges to establish proper parameters.

6. Analog Input Calibration

   a. Sensors shall be calibrated as specified on the points list. Calibration methods shall be one of the following:

      1) Factory: Calibration by factory, to standard factory specifications. Field calibration is not required.

      2) Handheld: Field calibrate using a handheld device with accuracy meeting the requirements of Paragraph 2.10.

   b. The calibrating parameters in software (such as slope and intercept) shall be adjusted as required. A calibration log shall be kept and initialed by the technician indicating date and time, sensor and hand-held readings, and calibration constant adjustments and included in the Pre-functional Test Report.

   c. Inaccurate sensors must be replaced if calibration is not possible.

7. Alarms and Interlocks

   a. A log shall be kept and initialed by the technician indicating date and time, alarm/interlock description, action taken to initiate the alarm/interlock, and resulting action, and included in the Pre-functional Test Report.

   b. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

   c. Coordinate with Division 26 to test fire and life safety systems alarm contacts.

   d. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

   e. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

8. Variable Frequency Drive Minimum Speed

   a. Minimum speed for VFD-driven fans and pumps shall be determined in accordance with this Paragraph. Tests shall be done for each piece of equipment, except that for multiple pieces of identical equipment used for identical applications, only one piece of equipment need be tested with results applied to all. Note that for fans and pumps, there is no minimum speed required for motor cooling. Power drops with cube of speed, causing motor losses to be minimal at low speeds.

b. This work shall be done only after fan/pump system is fully installed and operational.

c. Determine minimum speed setpoint as follows:

1) Start the fan or pump.

2) Manually set speed to 6 Hz (10%) unless otherwise indicated in control sequences. For cooling towers with gear boxes, use 20% or whatever minimum speed is recommended by tower manufacturer.

3) Observe fan/pump in field to ensure it is visibly rotating.

a) If not, gradually increase speed until it is.

4) The speed at this point shall be the minimum speed setpoint for this piece of equipment.

5) Record minimum speeds in log and store in software point as indicated in Guideline 36.

9. Tuning

a. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the Pre-functional Test Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted)

Controlled Variable	Control Accuracy
Duct Pressure	±0.1 inches w.g.
Building and relief plenum	±0.01 inches w.g.
Airflow and water flow	±10%
Space Temperature	±1.5ºF
Condenser Water Temperature	±2ºF
Chilled Water Temperature	±1ºF
Hot Water Temperature	±3ºF
Duct Temperature	±2ºF
Water Differential Pressure	±1.5 psi
Others	±2 times reported accuracy

10. Interface and Control Panels

a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the Record Drawings.

b. Ensure that terminations are safe, secure and labeled in accordance with the Record Drawings.

c. Check power supplies for proper voltage ranges and loading.

d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.

e. Check for adequate signal strength on communication networks.

f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.

g. Ensure that buffered or volatile information is held through power outage.

h. With all system and communications operating normally, sample and record update and annunciation times for critical alarms fed from the panel to the Operator Interface.

i. Check for adequate grounding of all BAS panels and devices.

11. Operator Interfaces

a. Verify that all elements on the graphics are functional and are properly bound to physical devices or virtual points, and that hot links or page jumps are functional and logical.

b. Verify that the alarm logging, paging, emailing etc. are functional and per requirements.

E. Testing, Adjusting, and Balancing (TAB) Coordination

1. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing. Some balancing procedures require the BAS to be operational and require Contractor time and assistance.

2. Calibration Software

a. Software shall be provided free of charge on at least a temporary basis to allow calibration of terminal box airflow controls and other Work specified under Section 230593 Testing, Adjusting, and Balancing.

b. Software shall be provided for installation on POT(s) provided by Others or Contractor shall loan a POT or handheld device with software installed for the duration of Work specified under Section 230593 Testing, Adjusting, and Balancing.

c. Provide sufficient training to those performing Work specified under Section 230593 Testing, Adjusting, and Balancing to allow them to use the software for balancing and airflow calibration purposes. Contractor shall include a single training session for this purpose.

3. Setpoint Determination

a. Perform pre-functional tests described in Paragraph 3.15D before assisting in setpoint determination.

b. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing to determine fan and pump differential pressure setpoints, outdoor air damper minimum positions and DP setpoints, etc. as indicated in Section 230593 Testing, Adjusting and Balancing.

F. Functional Tests

1. Test schedule shall be coordinated with the Commissioning Provider, Commissioning Coordinator, and College's Representative.

2. Functional tests may be witnessed by College's Representative at the College's option.

3. All approved Functional Tests shall be conducted by the Contractor with results confirmed and signed by the Contractor's start-up technician.

4. Test documentation

a. College's Representatives will prepare functional testing forms after Submittal Package 2 has been reviewed and approved. Tests will be designed to test all sequences in a formal manner with simulations and expected outcomes.

b. Review tests and recommend changes that will improve ease of testing or avoid possible system damage, etc. and provide to College's Representative.

c. Complete work, document results on forms, and submit for approval as Submittal Package 6 Functional Test Report. Tutorials for using the functional test Excel workbook can be found at http://www.taylor-engineering.com/functional-performance-test-guidelines.

G. Demonstration Test

1. Demonstration tests consist of a small representative sample of functional tests and systems randomly selected by the Commissioning Provider. Tests will be designed to occur over no longer than 2 working days.

2. Schedule the demonstration with the Commissioning Provider and College's Representative at least 1 week in advance. Demonstration shall not be scheduled until the Functional Test Report has been approved.

3. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. 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.

4. 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 Provider will supply the test forms at the site at the start of the tests.

5. Demonstration tests may be witnessed by College's Representative at the College's option.

6. Contractor shall conduct tests as directed by and in the presence of the Commissioning Provider and complete test forms. Commissioning Provider will document the test results as the Demonstration Test Report after tests are complete.

7. Demonstration Tests shall be successfully completed and approved prior to Substantial Completion.

H. Trend Log Tests

1. Trends shall be fully configured to record and store data to the server for the points and at the interval listed in Paragraph 2.11 as follows:

   a. Commissioning: Configure trends prior to functional testing phase. Retain configuration until post-construction commissioning trend review has been completed successfully and accepted by the College's representative. Trends shall be deactivated after acceptance.

   b. Continuous: After system acceptance, configure trends for the purpose of long term future diagnostics. Configure trends to overwrite the oldest trends at the longest interval possible without filling the server hard disk beyond 80%.

2. Post-Construction Trend Test

   a. Trend logging shall not commence until Demonstration Tests are successfully completed.

   b. Hardware Points. Contractor shall configure points to trend as indicated in the Commissioning Trend column listed in Paragraph 2.11 points.

   c. Software Points. Include the following in trends of systems and zones whose hardware points are being trended as called for above. Time interval shall be the same as associated hardware point.

1) All setpoints and limits that are automatically reset, such as supply air temperature and fan static pressure setpoints, plus the points that are driving the reset, such as zone level cooling and static pressure requests

2) All setpoints that are adjustable by occupants

3) Outputs of all control loops, other than those driving a single AO point that is already being trended

4) System mode points (e.g. Warm-up, Occupied, etc.)

5) Global overrides such as demand shed signals

6) Calculated performance monitoring points, such as chiller efficiency

d. Submit for review and approval by the Commissioning Provider a table of points to be trended along with trend intervals or change-of-value a minimum of 14 days prior to trend collection period, as Submittal Package 5.

e. Trends shall be uploaded to the CSS in data format specified in Paragraph **Error! Reference source not found.**.

f. Trend logs of all points indicated above shall be collected for a 3 week Trend Period.

g. At the completion of the Trend Period, data shall be reviewed by the Contractor to ensure that the system is operating properly. If so, data shall be submitted to the College in an electronic format agreed to by the College and Contractor (such as flash drive or via direct access to the CSS via the internet) as Submittal Package 8.

h. Data will be analyzed by the Commissioning Provider.

i. The system shall be accepted only if the trend review indicates proper system operation without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. If any but very minor glitches are indicated in the trends, steps f to h above shall be repeated for the same Trend Period until there is a complete Trend Period of error free operation.

j. After successfully completing the Post-Construction Trend Tests, the Contractor shall configure all points to trend as indicated in the Continuous Trend column listed in Paragraph 2.11 points list.

I. Remedial Work

1. Repair or replace defective Work, as directed by College's Representative in writing, at no additional cost to the College.

2. Restore or replace damaged Work due to tests as directed by College's Representative in writing, at no additional cost to the College.

3. Restore or replace damaged Work of others, due to tests, as directed by College's Representative in writing, at no additional cost to the College.

4. Remedial Work identified by site reviews, review of submittals, demonstration test, trend reviews, etc. shall be performed to the satisfaction of the College's Representative, at no additional cost to the College.

5. Contractor shall compensate College's Representatives and Commissioning Provider 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 College.

3.16 TRAINING

A. Coordinate schedule and materials with Commissioning Provider.

B. Interim Training

1. Provide minimal training so the operating staff can respond to occupant needs and other operating requirements during start-up and commissioning phase.

C. Formal Training

1. Provide training sessions for personnel indicated in Paragraph 3.16G.

2. Submit training materials as Submittal Package 7.

3. Training shall be conducted after all commissioning is complete and systems are fully operational.

4. Off-site Primary System Training

a. Training on basic BAS functions as listed in Paragraph 3.16C.4 shall be given off-site by the primary manufacturer's training staff, either at the factory or at a permanent training facility. Training by Contractor staff is not acceptable.

b. The appropriate level of training shall be provided for each of the persons listed in Paragraph 3.16G.

c. The length of each training period will depend on the complexity of the system and the audience, described below. Minimum training shall be 24 hours per trainee, but period shall be longer if required to complete the training tasks described below.

d. Expenses for transportation to and from the training facility, hotel, and meals shall be provided by the College and excluded from the BAS bid. Cost for

books, manuals and any other type of training equipment or material shall be included in the BAS bid.

5. On-Site Training

    a. Include 40 hours total of on-site training to assist personnel in becoming familiar with site-specific issues, systems, control sequences, etc.

    b. College shall be permitted to videotape training sessions.

    c. Training may be in non-contiguous days at the request of the College.

6. During the warranty period, provide unlimited telephone support for all trained operators.

D. Operators are divided into three categories and shall receive training including but not limited to the tasks listed.

1. Day-to-day Operators shall be trained to

    a. Proficiently operate the system

    b. Understand control system architecture and configuration

    c. Understand BAS system components

    d. Understand system operation and control sequences

    e. Operate the workstation and peripherals

    f. Log on and off the system

    g. Access graphics, point reports, and logs

    h. Adjust and change system set points, time schedules, and holiday schedules

    i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals

    j. Understand and acknowledge alarms

    k. Understand system drawings, and Operation and Maintenance manual

    l. Understand the Project layout and location of control components

    m. Print point and predefined reports

2. Advanced Operators shall be trained to do all items for Day-to-Day operators plus

a. Make and change graphics on the workstation

b. Create, delete, and modify alarms, including annunciation and routing

c. Create, delete, and modify point trend logs, and graph or print these both on an ad-hoc basis and at user-definable time intervals

d. Create, delete, and modify reports

e. Add, remove, and modify system's physical points

f. Create, modify, and delete programming

g. Add control panels

h. Add Operator Workstations

i. Create, delete, and modify system displays — both graphical and otherwise

j. Perform BAS system field checkout procedures

k. Perform BAS controller unit operation and maintenance procedures

l. Perform workstation and peripheral operation and maintenance procedures

m. Perform BAS system diagnostic procedures

n. Configure hardware including PC boards, switches, communication, and I/O points

o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware

p. Adjust, calibrate, and replace system components

q. Maintain software and prepare backups

3. System Managers/Administrators shall be trained to do all items for Day-to-Day operators plus

a. Maintain software and prepare backups

b. Create and print custom reports, including tenant billing summaries

c. Interface with project-specific, third-party operator software

d. Add new users and understand password security procedures

E. Training materials shall include step-by-step instructions (including illustrations, screen captures, etc.) for how to perform all task identified in Paragraph 3.16C.4 such that a new Operator, who has not attended the training in person and has

minimal familiarity with this BAS system, can easily follow the instructions and successfully perform all of the identified tasks. One copy of training material shall be provided per student. An electronic copy of the materials shall be stored on the OWS.

F. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

G. The type and number of personnel and location for training shall include

1. Day-to-day Operator: 2

2. Advanced Operator: 1

3. System Managers/Administrators: 1

END OF SECTION 25 00 00

PART 1 GENERAL

1.1 SUMMARY

A. Program and commission the Building Automation System (BAS) to execute the Sequences of Operation specified herein.

B. See Section 250000 Building Automation Systems for general requirements.

C. These control sequences include references to ASHRAE Guideline 36 and approved addenda. Where sequences are verbatim from Guideline 36, they are shown in green text. Not all informative text has been included. Sequences have been customized to include only Title 24 options where they take precedence over ASHRAE 90.1 and 62.1 requirements.

D. Guideline 36 sequences shall be programmed to exactly match the specified sequences verbatim. The Contractor may use “equivalent” alternative sequences only with formal approval by the Engineer. Proposed changes in sequences shall be clearly identified and included as a part of Submittal Package 2.

E. This file shall be maintained by the Contractor to include all approved changes to sequences made during testing and commissioning and shall become the final as-built sequences of operation installed on the CSS per Section 250000 Building Automation Systems.

1.2 INFORMATION PROVIDED BY DESIGNER

A. See equipment schedules on drawings for all setpoints unless otherwise noted below.

B. General Zone Information

1. Zone Temperature Setpoints

a. Default setpoints shall be based on zone type as shown in Table 3.1.1.1.

Table 3.1.1.1 Default Setpoints

	Occupied		Unoccupied	
Zone Type	Heating	Cooling	Heating	Cooling
General (unless listed below)	70ºF	75ºF	60ºF	90ºF
IDF/MDF	–	78ºF	–	78ºF

2. Outdoor Air Ventilation Setpoints

    a. All zone minimum outdoor air setpoints are scheduled on Drawings.

        1) Vocc-min. Zone minimum outdoor airflow for occupants.

        2) Varea-min. Zone minimum outdoor airflow for building area.

        3) Indicate where occupied-standby mode is allowed based on the zone occupancy category.

3. CO2 Setpoints

    a. The CO2 setpoint for all occupancy types is 1000 ppm.

C. VAV Box Design Information

1. All VAV box setpoints are scheduled on Drawings except as indicated below.

2. VAV Cooling-Only Terminal Unit

    a. Zone maximum cooling airflow setpoint (Vcool-max)

    b. Zone maximum heating airflow setpoint (Vheat-max)

    c. Zone minimum airflow setpoint (Vmin). This is an optional entry. If no value is scheduled, or a value of “AUTO” is scheduled, Vmin will be calculated automatically and dynamically to meet ventilation requirements.

D. Zone Group Assignments

1. Unless otherwise specified by Owner, the following Zone Groups shall be created:

Zone Group Name	AH Tag	Terminal Unit Tags	Miscellaneous Equipment Tags	Default Schedule
First and second floors	AHU-1	All L1 and L2 VAVs		WD: 6 am to 8pm WE: off HOL: off
Third and fourth floors	AHU-1	All L3 and L4 VAVs		WD: 6 am to 8pm WE: off HOL: off
Fifth and sixth floors	AHU-1	All L5 and L6 VAVs		WD: 6 am to 8pm WE: 8 am to 8pm HOL: off

E. Multiple-Zone VAV Air-Handler Design Information

1. Temperature Setpoints

a. Min_ClgSAT, lowest cooling supply air temperature setpoint = scheduled cooling coil leaving air temperature plus 3°F

b. Max_ClgSAT, highest cooling supply air temperature setpoint = 65°F

c. OAT_Min, the lower value of the OAT reset range = 55°F

d. OAT_Max, the higher value of the OAT reset range = 70°F

2. Ventilation Setpoints

a. All AHU outdoor airflow setpoints are scheduled on Drawings.

1) AbsMinOA, the design outdoor air rate when all zones with CO2 sensors or occupancy sensors are unpopulated

2) DesMinOA, the design minimum outdoor airflow with areas served by the system are occupied at their design population, including diversity where applicable

3. Economizer High Limit

a. California Title 24 economizer high limit

1) California climate zone = 3

2) High limit option:

a) Fixed dry bulb + differential dry bulb

4. DP100, filter high limit differential pressure at design airflow = 1 in.w.c. or value from manufacturer's submittal whichever is lower

F. Dual-Fan Dual-Duct VAV Air-Handler Design Information

1. Temperature Setpoints

a. Max_HtgSAT, highest heating supply air temperature = scheduled heating coil leaving air temperature

2. DP100, filter high limit differential pressure at design airflow = 1 in.w.c. or value from manufacturer's submittal whichever is lower

1.3 INFORMATION PROVIDED BY (OR IN CONJUNCTION WITH) THE TESTING, ADJUSTING, AND BALANCING CONTRACTOR

A. Coordinate with Section 230593 Testing, Adjusting and Balancing for setpoint determination. Any work not specifically listed in Section 230593 shall be provided under this Section.

B. Multiple-Zone Air-Handler Information

1. Duct Design Maximum Static Pressure, Max_DSP

2. Minimum Fan Speed

a. Minimum speed setpoints for all VFD-driven equipment shall be determined in accordance with Section 250000 Building Automation System specifications for the following, as applicable:

1) Supply fan

2) Relief fan

3. Ventilation Plenum Pressures. (For minimum outdoor air control with separate outdoor air damper and differential pressure [DP] control, see Section 3.9D.)

a. For projects complying with California Title 24 Ventilation Standards:

1. AbsMinDP, the absolute minimum outdoor air damper DP that provides an outdoor airflow equal to the absolute minimum outdoor airflow AbsMinOA

2. DesMinDP, the design minimum outdoor air damper DP that provides the design minimum outdoor airflow DesMinOA.

1.4 INFORMATION DETERMINED BY CONTROL CONTRACTOR

A. VAV Box Controllable Minimum

1. This section is used to determine the lowest possible VAV box airflow setpoint (other than zero) allowed by the controls (Vm) used in VAV box control sequences. The minimums shall be stored as software points that may be adjusted by the user but need not be adjustable via the graphical user interface.

2. Option 1: If the VAV box controller can control to 0.004" per Section 250000 Building Automation Systems, the minimum setpoint *Vm* shall be determined from the table below if the VAV box manufacturer is listed:

Inlet	Titus	Krueger	Price	MetalAire High Gain	ETI
4	15	15	20	15	15
6	30	35	30	30	30
8	55	60	55	50	55
10	90	90	95	85	90
12	120	130	135	110	130
14	190	175	195	155	180
16	245	230	260	210	235
24x16	455	445	490	N/A	415

3. Option 2: The minimum setpoint *Vm* shall be determined per Guideline 36.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Contractor shall review sequences prior to programming and suggest modifications where required to achieve the design intent. Contractor may also suggest modifications to improve performance and stability or to simplify or reorganize logic in a manner that provides equal or better performance. Proposed changes in sequences shall be clearly identified and included as a part of Submittal Package 2.

B. Include costs for minor program modifications if required to provide proper performance of the system.

C. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup.

D. When a control loop is enabled or reenabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a neutral value.

E. 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.

F. 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 the unit is in Occupied Mode or in any other mode with the economizer enabled.

   2. The outdoor air temperature used for 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.

G. The term “proven” (i.e., “proven on”/“proven off”) shall mean that the equipment’s DI status point (where provided, e.g., current switch, DP switch, or VFD status) matches the state set by the equipment’s DO command point.

H. The term “software point” shall mean an analog variable, and “software switch” shall mean a digital (binary) variable, that are not associated with real I/O points. They shall be read/write capable (e.g., BACnet analog variable and binary variable).

I. The term “control loop” or “loop” is used generically for all control loops. These will typically be PID loops, but proportional plus integral plus derivative gains are not required on all loops. Unless specifically indicated otherwise, the guidelines in the following subsections shall be followed.

   1. Use proportional only (P-only) loops for limiting loops (such as zone CO2 control loops, etc.).

   2. Do not use the derivative term on any loops unless field tuning is not possible without it.

J. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change, with a default of 25% per minute.

K. 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.

L. 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. Exceptions shall be made for machine or life safety.

M. Alarms

1. There shall be 4 levels of alarm

    a. Level 1: Life-safety message

    b. Level 2: Critical equipment message

    c. Level 3: Urgent message

    d. Level 4: Normal message

2. Maintenance Mode. Operators shall have the ability to put any device (e.g., AHU) in/out of maintenance mode.

    a. All alarms associated with a device in maintenance mode will be suppressed. Exception: Life safety alarms shall not be suppressed.

    b. If a device is in maintenance mode, issue a daily Level 3 alarm at a scheduled time indicating that the device is still in maintenance mode.

3. Exit Hysteresis

    a. Each alarm shall have an adjustable time-based hysteresis (default: 5 seconds) to exit the alarm. Once set, the alarm does not return to normal until the alarm conditions have ceased for the duration of the hysteresis.

    b. Each analog alarm shall have an adjustable percent-of-limit-based hysteresis (default: 0% of the alarm threshold, i.e., no hysteresis; alarm exits at the same value as the alarm threshold) the alarmed variable required to exit the alarm. Alarm conditions have ceased when the alarmed variable is below the triggering threshold by the amount of the hysteresis.

4. Latching. A latching alarm requires acknowledgment from the operators before it can return to normal, even if the exit deadband has been met. A nonlatching alarm does not require acknowledgment. Default latching status is as follows:

    a. Level 1 alarms: latching

    b. Level 2 alarms: latching

    c. Level 3 alarms: nonlatching

    d. Level 4 alarms: nonlatching

5. Post-exit Suppression Period. To limit alarms, any alarm may have an adjustable suppression period such that once the alarm is exited, its post-exit suppression timer is triggered and the alarm may not trigger again until the post-exit suppression timer has expired. Default suppression periods are as follows:

    a. Level 1 alarms: 0 minutes

b. Level 2 alarms: 5 minutes

c. Level 3 alarms: 24 hours

d. Level 4 alarms: 7 days

N. VFD Speed Points

To avoid operator confusion, the speed command point (and speed feedback point, if used) for VFDs should be configured so that a speed of 0% corresponds to 0 Hz, and 100% corresponds to maximum speed set in the VFD, not necessarily 60 Hz. The maximum speed may be limited below 60 Hz to protect equipment, or it may be above 60 Hz for direct drive equipment. Drives are often configured such that a 0% speed signal corresponds to the minimum speed programmed into the VFD, but that causes the speed AO value and the actual speed to deviate from one another.

1. The speed AO 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.

It is desirable that the minimum speed reside in the VFD to avoid problems when the VFD is manually controlled at the drive. But minimums can also be adjusted inadvertently in the VFD to a setpoint that is not equal to the minimum used in software. The following prevents separate, potentially conflicting minimum speed setpoints from existing in the BAS software and the drive firmware.

2. For each piece of equipment, the minimum speed shall be stored in a single software point; in the case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BAS. See Section 1.3 for minimum speed setpoints. The active minimum speed parameter shall be read every 60 minutes via the drive's network interface. When a mismatch between the drive's active minimum speed and the minimum speed stored in the software point is detected, the minimum speed stored in the software point shall be written to the VFD via the network interface to restore the active minimum speed parameter to its default value, and generate a Level 4 alarm.

The minimum speed parameter is read via the network interface to detect any changes in the minimum speed parameter. Upon detecting a change in the minimum speed setting, the correct minimum speed stored in a BAS software point is written back to the drive via the network interface to override any changes that are made locally to the minimum speed parameter at the VFD.

O. Trim & Respond Set-Point Reset Logic

1. T&R set-point reset logic and zone/system reset requests, where referenced in sequences, shall be implemented as described below.

2. A "request" is a call to reset a static pressure or temperature setpoint generated by downstream zones or air-handling systems. These requests are sent

upstream to the plant or system that serves the zone or air handler that generated the request.

a. For each downstream zone or system, and for each type of set-point reset request listed for the zone/system, provide the following software points:

1) Importance-Multiplier (default = 1)

Importance-Multiplier is used to scale the number of requests the zone/system is generating. 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.

2) Request-Hours Accumulator. Provided SystemOK (see Section 3.1R) is true for the zone/system, every x minutes (default 5 minutes), add x divided by 60 times the current number of requests to this request-hours accumulator point.

3) System Run-Hours Total. This is the number of hours the zone/system has been operating in any mode other than Unoccupied Mode.

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, because a single rogue zone can keep the T&R loop at maximum and prevent it from saving any energy.

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.

5) The Request-Hours Accumulator and System Run-Hours Total are reset to zero as follows:

a) Reset automatically for an individual zone/system when the System Run-Hours Total exceeds 400 hours.

b) Reset manually by a global operator command. This command will simultaneously reset the Request-Hours point for all zones served by the system.

6) A Level 4 alarm is generated if the zone Importance-Multiplier is greater than zero, the zone/system Cumulative% Request Hours exceeds 70%, and the total number of zone/system run hours exceeds 40.

b. See zone and air-handling system control sequences for logic to generate requests.

c. Multiply the number of requests determined from zone/system logic times the Importance-Multiplier and send to the system/plant that serves the

zone/system. See system/plant logic to see how requests are used in T&R logic.

3. 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. See Table 5.1.14.3.

Table 5.1.14.3 Trim & Respond Variables

Variable	Definition
Device	Associated device (e.g., fan, pump)
SP0	Initial setpoint
SPmin	Minimum setpoint
SPmax	Maximum setpoint
Td	Delay timer
T	Time step
I	Number of ignored requests
R	Number of requests from zones/systems
SPtrim	Trim amount
SPres	Respond amount (must be opposite in sign to SPtrim)
SPres-max	Maximum response per time interval (must be same sign as SPres)

Informative Note: The number of ignored requests (I) should be set to zero for critical zones or air handlers.

4. Trim & Respond logic shall reset the setpoint within the range SPmin to SPmax. When the associated device is off, the setpoint shall be SP0. 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, if R≤I, trim the setpoint by SPtrim. If there are more than I requests, respond by changing the setpoint by SPres*(R – I), (i.e., the number of requests minus the number of ignored requests) but no more than SPres-max. In other words, every time step T.

If R≤I, change Setpoint by SPtrim
If R > I, change setpoint by (R – I)*SPres but no larger than SPres-max

P. Equipment Staging and Rotation

1. Parallel equipment shall be lead/lag or lead/standby rotated to maintain even wear.

2. Two runtime points shall be defined for each equipment:

   a. Lifetime Runtime: The cumulative runtime of the equipment since equipment start-up. This point shall not be readily resettable by operators.

Lifetime Runtime should be stored to a software point on the control system server so the recorded value is not lost due to controller reset, loss of power, programming file update, etc.

   b. Staging Runtime: An operator resettable runtime point that stores cumulative runtime since the last operator reset.

Staging Runtime provides a resettable runtime counter, which allows for reset of the staging runtime hours used for lead/lag or lead/standby rotation between maintenance intervals or equipment replacement while maintaining a separate log of the Lifetime Runtime. If runtime were not resettable, and logic relied only on Lifetime Runtime for determining staging lead/lag position, newly added equipment could run for years as the lead equipment before swapping rotation positions with older equipment per the logic below.

3. Lead/lag equipment: Unless otherwise noted, identical parallel staged equipment (such as CHW pumps and cooling towers) shall be lead/lag alternated when more than one is off or more than one is on so that the equipment with the most operating hours as determined by Staging Runtime is made the last stage equipment and the one with the least number of hours is made the lead stage equipment.

This strategy effectively makes it such that equipment are not "hot swapped", e.g., a pump would not be started and another stopped during operation just for runtime equalization.
For example, assume there are two equipment and only one is on, but the operating equipment has exceeded the run hours of the disabled equipment. The equipment will not rotate positions until either a stage up or down occurs. If the plant stages up, then both equipment will be on and lead/lag position will switch; when the plant next stages down, the former lead equipment with more run hours will then turn off.
Expanding further, for a plant with three equipment, 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 equipment are on, the one with more 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 equipment were started. If two of the equipment are off, the one with the more 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 equipment were stopped.
Example with three pumps:

1. *P-1 (1000 hours), 2 (950 hours), and 3 (900 hours) are all off. Staging logic makes lead/lag order: 3, 2, 1.*
2. *P-3 starts. Logic does not change its order since it is on by itself.*
3. *P-3 runs for 51 hours. Since it is on and others off, the lead/lag order does not change. It can run this way indefinitely and the order does not change.*

4. *There is then a stage-up command. P-2 (the next in lead/lag order) is started. So, both P-2 and P-3 are on. P-3 now has more run hours than P-2. So, the Lead/lag order changes to: 2, 3, 1.*
5. *These two pumps run another 51 hours. Run times are P-1 (1000 hours), P-2 (1001), and P-3 (1002). No changes are made to lead/lag order because P-1 is off alone.*
6. *There is a stage down command. P-2 is now lead so it stays on. P-3 is shut off. The order for the two off pumps is now adjusted because P-1 has fewest run hours. Lead/lag order is now: 2, 1, 3.*
7. *P-2 runs for 100 more hours. It now has the longest runtime, but order does not change since it is on alone. Order is still 2, 1, 3.*
8. *There is a stage down or plant-off command. P-2 shuts off. Run times are P-1 (1000 hours), P-2 (1101), and P-3 (1002). Since all are off, order is switched to: 1, 3, 2.*

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4. Lead/standby equipment:

   a. Unless equipment runs continuously, parallel equipment that are 100% redundant shall be lead/standby alternated when more than one of the equipment is off so that the equipment with the most operating hours as determined by Staging Runtime is made the last stage equipment and the one with the least number of hours is made the earlier stage equipment.

For example, assuming there are three equipment, if all three are off, the staging order will be based on run hours from lowest to highest.

   b. If equipment runs continuously, lead/standby positions shall switch at an adjustable day of the week and time (e.g., every Tuesday at 10:00 am) based on Staging Runtime; standby equipment shall first be started and proven on before former lead equipment is changed to standby and shut off.

      1) Variable speed fans and pumps shall have a deceleration rate of 1 Hz/second or slower set in BAS logic when disabled to prevent nuisance trips of operating equipment (e.g., chillers).

5. Exceptions to Lead/lag and Lead/standby rotation

   a. Operators with appropriate access level shall be able to manually command staging order via software points, but not overriding the In-Alarm or Hand-Operation logic in the following subsections.

      1) Staging order changes initiated via operator override shall be instituted as part of normal staging events.

      2) Staging order shall remain overridden until released by operators.

   b. Faulted Equipment:

1) A faulted equipment is any equipment commanded to run that is either not running or unable to perform its required duty. If an operating equipment has any fault condition described subsequently, a Level 2 alarm shall be generated and a response shall be triggered as defined below.

    a) Fans and Pumps

        1. Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds while the equipment is commanded on.

2) Upon identification of a fault condition:

    a) For fans, pumps:

        1. The next commanded off equipment in the staging order, Equipment “B”, shall be commanded on while alarming Equipment “A” remains commanded on.

        2. If Equipment “B” fails to prove status (i.e., it also goes into alarm), it shall remain commanded on and the preceding step shall be repeated until the quantity of equipment called for by the current stage has proven on, or there are no more available equipment.

        3. Set alarming equipment to the last positions in the lead/lag or lead/standby staging order sequenced reverse chronologically (i.e., the equipment that alarmed most recently is sent to last position).

        4. Staging order of non-alarming equipment shall follow the even wear logic. Equipment in alarm can only automatically move up on the staging order if another equipment goes into alarm.

        5. Equipment in alarm shall run if so called for by the lead/lag or lead/standby staging order and present stage.

3) Fans and Pumps

    a) Status point not matching its on/off point for 15 seconds after a time delay of 60 seconds when the equipment is commanded off.

Logic for hand operation of chillers, boilers, and cooling towers is not provided because sequences cannot stably respond to overrides by operators in all possible scenarios. For example, if a chiller is turned on in hand in a variable primary system with only one other chiller currently running, the control system would need to react by opening the isolation valves of the chiller placed in hand and either (1) immediately shutting down the former lead chiller or (2) changing the minimum chilled water flow setpoint, opening isolation valves, and possibly staging on condenser water pumps and cooling towers. Chillers, boilers, and cooling towers should only be placed in hand by changing the

staging sequence manually via the control system interface; they cannot be safely or stably operated in hand at the chiller/boiler/tower controllers.

Q. Air Economizer High Limits

1. Economizer shall be disabled whenever the outdoor air conditions exceed the economizer high-limit setpoint as specified. Setpoints shall be automatically determined by the control sequences (to ensure they are correct and meet code) based on energy standard, climate zone, and economizer high-limit-control device type selected by the design engineer in Section 1.2E.3 or **Error! Reference source not found.**. Setpoints listed below are for current California Energy Standards.

2. Title 24-2019

Device Type	California Climate Zones	Required High Limit (Economizer off when)
Fixed dry bulb	3	TOA > 24°C (75°F)
Differential dry bulb	3	TOA > TRA

R. Hierarchical Alarm Suppression

1. For each piece of equipment or space controlled by the BAS, define its relationship (if any) to other equipment in terms of “source,” “load,” or “system.”

   a. A component is a “source” if it provides resources to a downstream component, such as a chiller providing chilled water (CHW) to an AHU.

   b. A component is a “load” if it receives resources from an upstream component, such as an AHU that receives CHW from a chiller.

   c. The same component may be both a load (receiving resources from an upstream source) and a source (providing resources to a downstream load).

   d. A set of components is a “system” if they share a load in common (i.e., collectively act as a source to downstream equipment, such as a set of chillers in a lead/lag relationship serving air handlers).

      1) If a single component acts as a source for downstream loads (e.g., an AHU as a source for its VAV boxes), then that single-source component shall be defined as a “system” of one element.

      2) For equipment with associated pumps (chillers, boilers, cooling towers):

         a) If the pumps are in a one-to-one relationship with equipment they serve, the pumps shall be treated as part of the system to which they

are associated (i.e., they are not considered loads), as a pump failure will necessarily disable its associated equipment.

b) If the pumps are headered to the equipment they serve, then the pumps may be treated as a system, which is a load relative to the upstream equipment (e.g., chillers) and a source relative to downstream equipment (e.g., air handlers).

2. For each system as defined in Section 3.1R.1.d, there shall be a SystemOK flag, which is either true or false.

3. SystemOK shall be true when all of the following are true:

   a. The system is proven on.

   b. The system is achieving its temperature and/or pressure setpoint(s) for at least 5 minutes

   c. The system is ready and able to serve its load

4. SystemOK shall be false while the system is starting up (i.e., before reaching setpoint) or when enough of the system's components are unavailable (in alarm, disabled, or turned off) to disrupt the ability of the system to serve its load. This threshold shall be defined by the design engineer for each system.

   a. By default, Level 1 through Level 3 component alarms (indicating equipment failure) shall inhibit SystemOK. Level 4 component alarms (maintenance and energy efficiency alarms) shall not affect SystemOK.

   b. The operator shall have the ability to individually determine which component alarms may or may not inhibit SystemOK.

5. The BAS shall selectively suppress (i.e., fail to announce; alarms may still be logged to a database) alarms for load components if SystemOK is false for the source system that serves that load.

   a. If SystemOK is false for a cooling water system (i.e., chiller, cooling tower, or associated pump), then only high-temperature alarms from the loads shall be suppressed.

   b. If SystemOK is false for a heating water system (i.e., boiler or associated pump), then only low temperature alarms from the loads shall be suppressed.

   c. If SystemOK is false for an air-side system (air handler, fan coil, VAV box, etc.), then all alarms from the loads shall be suppressed.

6. This hierarchical suppression shall cascade through multiple levels of load-source relationship such that alarms at downstream loads shall also be suppressed.

7. The following types of alarms will never be suppressed by this logic:

    a. Life/safety and Level 1 alarms

    b. Failure-to-start alarms (i.e., equipment is commanded on, but status point shows equipment to be off)

    c. Failure-to-stop/hand alarms (i.e., equipment is commanded off, but status point shows equipment to be on)

S. Time-Based Suppression

1. Calculate a time-delay period after any change in setpoint based on the difference between the controlled variable (e.g., zone temperature) at the time of the change and the new setpoint. The default time delay period shall be as follows:

    a. For thermal zone temperature alarms: 18 minutes per °C (10 minutes per °F) of difference but no longer than 120 minutes

    b. For thermal zone temperature cooling requests: 9 minutes per °C (5 minutes per °F) of difference but no longer than 30 minutes

    c. For thermal zone temperature heating requests: 9 minutes per °C (5 minutes per °F) of difference but no longer than 30 minutes

T. Occupancy Sensor Status

1. Occupancy status of all spaces shall be via the Lighting Control BACnet interface.

2. Where a zone serves more than one room, “unoccupied” (or “unpopulated” per Guideline 36 terminology) means all rooms are unoccupied and “occupied” (populated) means any room is occupied.

3. In case of the network connection with the Lighting Controls is lost:

U. Pandemic Mode

1. Provide a software switch on the Home Page graphic for Pandemic Mode on/off. The switch shall include a timer that can be manually set by the operator for a period of up to 60 weeks, after which the Mode shall be shut off and control logic and setpoints returned to normal.

2. When the Pandemic Mode timer is on:

    a. All CO2 DCV setpoints shall be set to 800 ppm.

b. Occupancy sensors used for Occupied Standby logic shall be not reset zone ventilation rates; with respect to ventilation, the zone shall be considered "populated".

c. All Zone Group time schedules shall indicate Occupied Mode one hour prior to the scheduled time. This earlier time shall be reflected in optimum start logic.

V. Wildfire Mode

1. Provide a 2-position software switch on the Home Page graphic for Wildfire Mode:

a. Off. Locks Wildfire Mode off.

b. On. Turns Wildfire Mode on for a preset period of time, after which the Mode shall be shut off. The preset time shall be operator adjustable for up to 1 week.

2. When the Wildfire Mode timer is on:

a. Disable all economizers (lock High Limit to off).

3.2 ELECTRICITY DEMAND LIMITING

*Automatic Demand Response is required by Title 24 for all non-healthcare systems with DDC to the zone.*Demand Response

1. On home page, provide three software switches: Demand Limit Level 1 to 3.

a. These switches shall have AUTO, ON, and OFF positions. AUTO position shall set the Demand Limit Level's status to enabled or disabled based on an OpenADR 2.0 signal from the utility (see Section 250000 Building Automation Systems) ON shall manually enable the Demand Limit Level; and OFF shall disable and lockout the Demand Limit Level.

b. The Highest Demand Limit Level signal currently enabled, either via an ON or AUTO command, shall be given priority.

c. These signals are used at the zone level (see Zone Control sequences) to adjust setpoints to reduce demand.

*Include this if we have a BACnet interface to lighting controls and want to initiate demand shed via BAS. Otherwise, the lighting control system will require a separate OpenADR 2.0 VEN for this purpose to comply with Title 24.*Include Demand Shed commands to the lighting control system via BACnet interface for each Demand Level. The response to each Demand Shed command shall be programmed into the lighting control system under Division 26.

3. When any Demand Limit Level is on, generate a Level 4 alarm.

3.3 GENERIC VENTILATION ZONES

A. Zone Minimum Outdoor Air and Minimum Airflow Setpoints

1. 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.

2. See Section 1.2C for zone minimum airflow setpoint Vmin.

3. For compliance with California Title 24, outdoor air setpoints shall be calculated as follows:

   a. See Section 1.2B.2 for zone ventilation setpoints.

   b. Determine the zone minimum outdoor air setpoints Zone-Abs-OA-min and Zone-Des-OA-min.

Zone-Abs-OA-min is used in terminal-unit sequences and air-handler sequences. Zone-Des-OA-min is used in air-handler sequences only.

      1) Zone-Abs-OA-min shall be reset based on the following conditions in order from highest to lowest priority:

         a) Zero if the zone has an occupancy sensor and is unpopulated and is permitted to be in occupied-standby mode per Section 1.2B.2.a.3).

         b) Varea-min if the zone has a CO2 sensor.

         c) Zone-Des-OA-min otherwise.

      2) Zone-Des-OA-min is equal to the following, in order from highest to lowest priority:

         a) Zero if the zone has an occupancy sensor, is unpopulated, and is permitted to be in occupied-standby mode per Section 1.2B.2.a.3).

         b) The larger of Varea-min and Vocc-min otherwise.

   c. Vmin

      1) Shall be equal to Zone-Abs-OA-min if Vmin in Section 1.2C is “AUTO”;

      2) Else shall be equal to Vmin as entered in Section 1.2C.

   d. The occupied minimum airflow Vmin* shall be equal to Vmin except as noted below, in order from highest to lowest priority:

1) If the zone has an occupancy sensor and is permitted to be in occupied-standby mode per Section 1.2B.2.a.3), Vmin* shall be equal to zero when the room is unpopulated.

2) If the zone has a CO2 sensor:

   a) See Section 1.2B.2.a.3) for CO2 setpoints.

   b) During Occupied Mode, a P-only loop shall maintain CO2 concentration at setpoint; reset from 0% at setpoint minus 200 PPM and to 100% at setpoint.

   c) Loop is disabled and output set to zero when the zone is not in Occupied Mode.

   d) For cooling-only VAV terminal units, dual-duct VAV terminal units with mixing control and inlet airflow sensors, or dual-duct VAV terminal units with cold-duct minimum control:

      1. The CO2 control loop output shall reset the occupied minimum airflow setpoint Vmin* from the zone minimum airflow setpoint Vmin at 0% up to maximum cooling airflow setpoint Vcool-max at 50%, as shown in Figure 5.2.1.4-1. The loop output from 50% to 100% will be used at the system level to reset outdoor air minimum; see AHU controls.

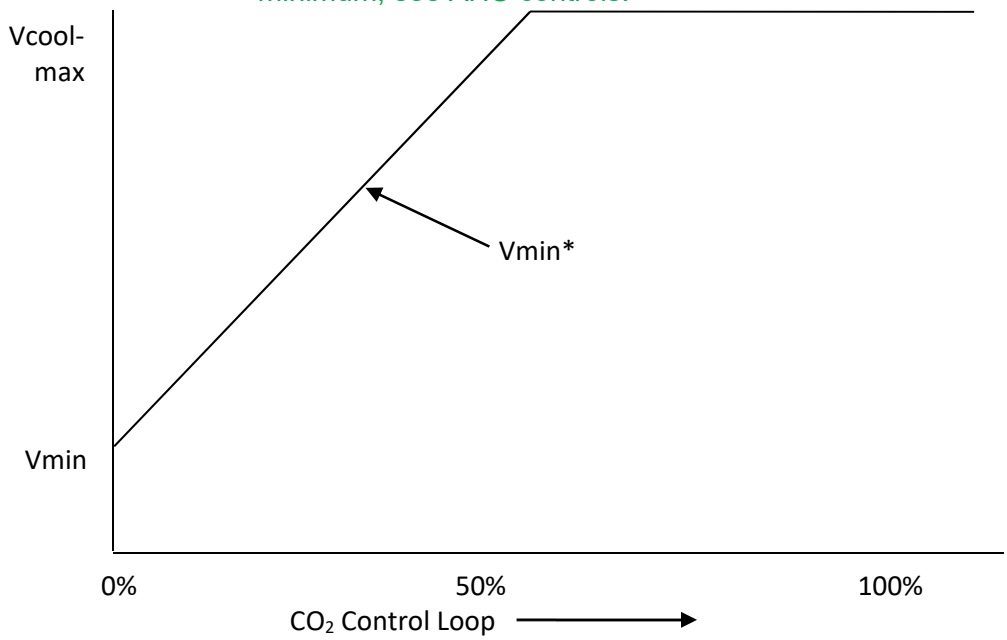


Figure 5.2.1.4-1 Vmin* reset with CO2 loop.

B. Time-Averaged Ventilation

ASHRAE Standard 62.1 and California Title 24 allow for ventilation to be provided based on average conditions over a specific period of time. This time-averaging

method allows for zone airflows to effectively be controlled to values below the VAV box controllable minimum value, which may reduce energy use and the risk of overcooling when the zone ventilation requirement is less than the VAV box controllable minimum.

1. When the active airflow setpoint Vspt is nonzero and is less than the lowest possible airflow setpoint allowed by the controls (Vm), the airflow setpoint shall be pulse width modulated as follows:

    a. The time-averaged ventilation (TAV) ratio shall be determined as TAVratio = Vspt/Vm

    b. The total cycle time (TCT) shall be 15 minutes (adjustable)

    c. Open period. During the open period, the TAV airflow setpoint Vspt* shall be equal to Vm for a period of time OP, which is the larger of the following:

    d. 1.5 minutes or

    e. TCT multiplied by TAVratio

    f. Closed period. During the closed period, Vspt* shall be set to 0 for a period of time CP, where CP = TCT – OP. The VAV damper control loop shall be disabled with output set equal to 0 during the closed period. At the end of each closed period, the VAV damper shall be commanded to the last position from the previous open period prior to reenabling the control loop.

    g. During TAV mode, each cycle shall consist of an open and closed period that alternate until Vspt is greater than Vm.

The following logic ensures that multiple zones do not enter TAV mode at the same time, avoiding the synchronized opening and closing of VAV dampers. Where there are a small number of zones and the majority may potentially be in TAV mode synchronously, avoiding this issue may be more reliably achieved by sequencing the VAV terminal units deterministically so that each VAV terminal unit always opens at a specific minute into the total cycle time. The aim of this sequencing is to ensure that the total airflow is as constant as possible over the total cycling time even if all of the VAV terminal units enter TAV mode at the same time (e.g., when a building-wide temperature setback occurs).
For example, the total open cycle for VAV terminal-unit A opens at minute 1 of the total cycle time, VAV terminal-unit B opens at minute x of the total cycle time, etc.
The random number for each terminal unit, RNDM, can be determined using a random number generator each time the unit enters TAV mode or set manually to a fixed value. If configured manually, set RNDM for each terminal unit to a unique value within the range of 0.0 to 1.0 such that the values are evenly distributed across the terminal units within a system.

    h. When first entering TAV mode, start with an initial open period of duration RNDM*OP, where RNDM is a random number between 0.0 and 1.0.

2. When in TAV mode, the active airflow setpoint, Vspt, shall be overridden to Vspt*.

C. Zone Alarms

1. For zones with CO2 sensors:

a. If the CO2 concentration is less than 300 ppm, or the zone is in Unoccupied Mode for more than 2 hours and zone CO2 concentration exceeds 600 ppm, generate a Level 3 alarm. The alarm text shall identify the sensor and indicate that it may be out of calibration.

b. If the CO2 concentration exceeds setpoint plus 10% for more than 10 minutes, generate a Level 3 alarm.

3.4 GENERIC THERMAL ZONES

A. This section applies to all single-zone systems and subzones of air-handling systems, such as VAV boxes, fan-powered boxes, etc.

B. Setpoints

1. See Section 1.2B.1 for zone temperature setpoints.

2. Each zone shall have separate occupied and unoccupied heating and cooling setpoints.

3. The active setpoints shall be determined by the operating mode of the Zone Group (see Section 3.5F).

The following is from addendum e to G36-2021:

a. During occupied mode:

1) The cooling set point shall be the occupied cooling set point.

2) The heating set point shall be the occupied heating set point.

b. During warm-up mode:

1) The cooling set point shall be the unoccupied cooling set point.

2) The heating set point shall be the unoccupied heating set point until the time remaining until the zone group's occupied start time is less than the zone's required warm-up time, tz-warmup, at which point the heating set point shall be the occupied heating set point.

c. During cool-down mode:

1) The cooling set point shall be the unoccupied cooling set point until the time remaining until the zone group's occupied start time is less than the zone's required cool-down time, tz-cooldown, at which point the cooling set point shall be the occupied cooling set point.

2) The heating set point shall be the unoccupied heating set point.

d. During setback mode:

1) The cooling set point shall be the unoccupied cooling set point.

2) The heating set point shall be 2°C (3°F) above the unoccupied heating set point.

e. During setup mode:

1) The cooling set point shall be 2°C (3°F) below the unoccupied cooling set point.

2) The heating set point shall be the unoccupied heating set point.

f. During unoccupied mode:

1) The cooling set point shall be the unoccupied cooling set point.

2) The heating set point shall be the unoccupied heating set point.

4. The software shall prevent the following:

a. The heating setpoint from exceeding the cooling setpoint minus 0.5°C (1°F) (i.e., the minimum difference between heating and cooling setpoints shall be 0.5°C [1°F]).

b. The unoccupied heating setpoint from exceeding the occupied heating setpoint.

c. The unoccupied cooling setpoint from being less than the occupied cooling setpoint.

5. Where the zone has a local setpoint adjustment knob/button:

a. 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.

b. The adjustment shall be capable of being limited in software.

These are absolute limits imposed by programming, which are in addition to the range limits (e.g., ±4°F) of the thermostat adjustment device.

1) As a default, the active occupied cooling setpoint shall be limited between 22°C (72°F) and 27°C (80°F).

2) As a default, the active occupied heating setpoint shall be limited between 18°C (65°F) and 22°C (72°F).

c. The active heating and cooling setpoints shall be independently adjustable, respecting the limits and anti-overlap logic described in Sections 3.4B.3.a and 3.4B.5.b. If zone thermostat provides only a single set-point adjustment, then the adjustment shall move both the active heating and cooling setpoints upward or downward by the same amount, within the limits described in Section 3.4B.5.b.

d. The adjustment shall only affect occupied setpoints in Occupied Mode, Warmup Mode, and Cooldown Mode and shall have no impact on setpoints in all other modes.

e. At the onset of demand limiting, the local set-point adjustment value shall be frozen. Further adjustment of the setpoint by local controls shall be suspended for the duration of the demand-limit event.

6. Cooling Demand Limit Set-Point 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 BAS user interface. Changes due to demand limits are not cumulative.

   a. At demand-limit Level 1, increase setpoint by 0.5°C (1°F).

   b. At demand-limit Level 2, increase setpoint by 1°C (2°F).

   c. At demand-limit Level 3, increase setpoint by 2°C (4°F).

7. Heating Demand-Limit Set-Point 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 BAS user interface. Changes due to demand limits are not cumulative.

   a. At demand-limit Level 1, decrease setpoint by 0.5°C (1°F).

   b. At demand-limit Level 2, decrease setpoint by 1°C (2°F).

   c. At demand-limit Level 3, decrease setpoint by 2°C (4°F).

Heating demand limits may be desirable in buildings with electric heat or heat pumps or in regions with limited gas distribution infrastructure.

8. Occupancy Sensors. For zones that have an occupancy switch:

a. When the switch indicates that the space has been unpopulated for 5 minutes continuously during the Occupied Mode, the active heating setpoint shall be decreased by 0.5°C (1°F) and the cooling setpoint shall be increased by 0.5°C (1°F).

b. When the switch indicates that the space has been populated for 1 minute continuously, the active heating and cooling setpoints shall be restored to their previous values.

C. Local Override. When thermostat override buttons are depressed, the call for Occupied Mode operation shall be sent to the Zone Group control for 60 minutes. Local Override shall be capable of being enabled and disabled separately for each thermostat via the graphical user interface; default to disabled.

Local overrides will cause all zones in the Zone Group to operate in Occupied Mode to ensure that the system has adequate load to operate stably.

D. Control Loops

1. Two separate control loops, the Cooling Loop and the Heating Loop, shall operate to maintain space temperature at setpoint.

   a. The Heating Loop shall be enabled whenever the space temperature is below the current zone heating set-point temperature and disabled when space temperature is above the current zone heating setpoint temperature and the loop output is zero for 30 seconds. The loop may remain active at all times if provisions are made to minimize integral windup.

   b. The Cooling Loop shall be enabled whenever the space temperature is above the current zone cooling set-point temperature and disabled when space temperature is below the current zone cooling set-point temperature and the loop output is zero for 30 seconds. The loop may remain active at all times if provisions are made to minimize integral windup.

2. The Cooling Loop shall maintain the space temperature at the active cooling setpoint. The output of the loop shall be a software point ranging from 0% (no cooling) to 100% (full cooling).

3. The Heating Loop shall maintain the space temperature at the active heating setpoint. The output of the loop shall be a software point ranging from 0% (no heating) to 100% (full heating).

4. Loops shall use proportional + integral logic or other technology with similar performance. Proportional-only control is not acceptable, although the integral gain shall be small relative to the proportional gain. P and I gains shall be adjustable by the operator.

5. See other sections for how the outputs from these loops are used.

E. Zone State

1. Heating. When the output of the space Heating Loop is nonzero and the output of the Cooling Loop is equal to zero.

2. Cooling. When the output of the space Cooling Loop is nonzero and the output of the Heating Loop is equal to zero.

3. Deadband. When not in either heating or cooling.

F. Zone Alarms

1. Zone Temperature Alarms

a. High-temperature alarm

1) If the zone is 2°C (3°F) above cooling setpoint for 10 minutes, generate a Level 4 alarm.

2) If the zone is 3°C (5°F) above cooling setpoint for 10 minutes, generate a Level 3 alarm.

b. Low-temperature alarm

1) If the zone is 2°C (3°F) below heating setpoint for 10 minutes, generate a Level 4 alarm.

2) If the zone is 3°C (5°F) below heating setpoint for 10 minutes, generate a Level 3 alarm.

Default time delay for zone temperature alarm (10 minutes) is intentionally long to minimize nuisance alarms. For critical zones, such as IT closets, consider reducing time delay or setting delay to zero.

c. Suppress zone temperature alarms as follows:

1) After zone setpoint is changed per Section 3.1S.

2) While Zone Group is in Warmup Mode or Cooldown Mode.

The following is from addendum e to G36-2021:

G. Zone Group Mode Requests

1. Zone Group Mode Requests shall be generated by the conditions in each zone and sent to the Zone Group of which the zone is a member.

2. Warm-up Mode Requests

a. An algorithm provided with the BAS shall calculate the required zone warm-up time, tz-warmup, which shall be less than 3 hours, based on the zone's occupied heating set point, the current zone temperature, the outdoor air temperature, and a heating mass/capacity factor for each zone.

b. The heating mass/capacity factor may be either manually adjusted or automatically self-tuned by the BAS. If automatic, the tuning process shall be turned ON or OFF by a software switch to allow tuning to be stopped after the system has been trained.

c. If the zone group is in any mode other than occupied mode and the time remaining until the zone group's occupied start time is less than the zone's required warm-up time, tz-warmup, send 1 Warm-up Mode Request; else, send 0 Warm-up Mode Requests.

3. Cooldown Mode Requests

a. An algorithm provided with the BAS shall calculate the required zone cool-down time, tz-cooldown, which shall be less than 3 hours, based on the zone's occupied heating set point, the current zone temperature, the outdoor air temperature, and a cooling mass/capacity factor for each zone.

b. The cooling mass/capacity factor may be either manually adjusted or automatically self-tuned by the BAS. If automatic, the tuning process shall be turned ON or OFF by a software switch to allow tuning to be stopped after the system has been trained.

c. If the zone group is in any mode other than occupied mode and the time remaining until the zone group's occupied start time is less than the zone's required cool-down time, t-cooldown, send 1 Cooldown Mode Request; else, send 0 Cooldown Mode Requests.

Warm-up and cooldown modes are used to bring the zone groups up to temperature based on their scheduled occupancy period. The algorithms used in these modes (often referred to as "optimal start") predict the shortest time to achieve occupied set point to reduce the central system energy use based on past performance.
It is recommended to use a global outdoor air temperature not associated with any AHU to determine warm-up start time. This is because unit-mounted OA sensors, which are usually placed in the outdoor air intake stream, are often inaccurate (reading high) when the unit is off due to air leakage from the space through the OA damper.

4. Setback Mode Requests

a. If the zone group is in unoccupied or setback mode and zone temperature is less than the unoccupied heating setpoint for 5 minutes, send 1 Setback Mode Request; else, send 0 Setback Mode Requests.

5. Setup Mode Requests

a. If the zone group is in unoccupied or setup mode and zone temperature is greater than the unoccupied cooling setpoint for 5 minutes, send 1 Setup Mode Requests; else, send 0 Setup Mode Requests.

3.5 ZONE GROUPS

Zone scheduling groups, or Zone Groups, are sets of zones served by a single air handler that operate together for ease of scheduling and/or in order to ensure sufficient load to maintain stable operation in the upstream equipment. A Zone Group is equivalent to an isolation area as defined in ASHRAE/IES Standard 90.1 and Title 24.

A. Each system shall be broken into separate Zone Groups composed of a collection of one or more zones served by a single air handler. See Section 1.2D for Zone Group assignments.

B. Each Zone Group shall be capable of having separate occupancy schedules and operating modes from other Zone Groups.

Note that, from the user's point of view, schedules can be set for individual zones, or they can be set for an entire Zone Group, depending on how the user interface is implemented. From the point of view of the BAS, individual zone schedules are superimposed to create a zone-group schedule, which then drives system behavior. The schedule may govern operation of other integrated systems such as lights, daylighting, or other, in addition to the HVAC system.

C. All zones in each Zone Group shall be in the same zone-group operating mode as defined in Section 3.5F. If one zone in a Zone Group is placed in any zone-group operating mode other than Unoccupied Mode (due to override, sequence logic, or scheduled occupancy), all zones in that Zone Group shall enter that mode.

Occupied-standby mode applies to individual zones, is considered a zonal subset of Occupied Mode, and shall not be considered a zone-group operating mode.

D. A Zone Group may be in only one mode at a given time.

E. For each Zone Group, provide a set of testing/commissioning software switches that override all zones served by the Zone Group. Provide a separate software switch for each of the zone-level override switches listed under "Testing and Commissioning Overrides" in terminal unit sequences. When the value of a Zone Group's override switch is changed, the corresponding override switch for every zone in the Zone Group shall change to the same value. Subsequently, the zone-level override switch may be changed to a different value. The value of the zone-level switch has no effect on the value of the zone-group switch, and the value of the zone-group switch only affects the zone-level switches when the zone-group switch is changed.

The testing and commissioning overrides will be specified for each type of terminal unit and system in subsequent sequences. These overrides allow a commissioning agent to, for example, force a zone into cooling or drive a valve all the way open or closed.

Zone-group override switches allow a commissioning agent to apply a zone-level override to all zones in a Zone Group simultaneously. This greatly accelerates the testing and commissioning process.

F. Zone-Group Operating Modes. Each Zone Group shall have the modes shown in the following subsections.

The modes presented in this section are to enable different setpoints and ventilation requirements to be applied to Zone Groups based on their operating schedule, occupancy status, and deviation from current setpoint.
See ASHRAE Guideline 13 for best practices in locating zone-group operating mode programming logic based on network architecture.

1. Occupied Mode. A Zone Group is in the Occupied Mode when any of the following is true:

   a. The time of day is between the Zone Group's scheduled occupied start and stop times.

   b. Any zone local override timer (initiated by local override button) is nonzero.

The following is from addendum e to G36-2021:

2. Warm-Up Mode. Warm-up mode shall start when the number of Warm-Up Mode Requests > I (I = ignores, default = 5), and shall end at the zone group's scheduled occupied start time or Warm-Up Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

3. Cool-down Mode. Cool-down mode shall start when the number of Cool-down Mode Requests > I (I = ignores, default to 5), and shall end at the zone group's scheduled occupied start time or Cool-down Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

4. Setback Mode. Setback mode shall start when the number of Setback Mode Requests > I (I = ignores, default to 4), and shall end when Setback Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

5. Setup Mode. Setup mode shall start when the number of Setup Mode Requests > I (I = ignores, default to 4), and shall end when Setup Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

Setback and setup modes are used to keep zone temperatures (and mass) from straying excessively far from occupied set points so that the cooldown and warm-up modes can achieve set point when initiated. The number of ignored zones (set at 4 here) are to ensure that the central systems (fans, pumps, heating sources, or cooling sources) can operate stably. Obviously, the size of the zones and the characteristics of the central systems are a factor in choosing the correct number of zones in each group.

3.6 DUAL-DUCT VAV TERMINAL UNIT − SNAP-ACTING CONTROL

A. See “Generic Thermal Zones” (Section 3.3C) for setpoints, loops, control modes, alarms, etc.

B. See “Generic Ventilation Zones” (Section 3.3) for calculation of zone minimum outdoor airflow.

C. See Section C.2.c for zone minimum airflow setpoint Vmin, maximum cooling airflow setpoint Vcool-max, and the zone maximum heating airflow setpoint Vheat-max.

D. Active endpoints used in the control logic depicted in Figures 5.11.5-1 and 5.11.5-2 shall vary depending on the mode of the Zone Group the zone is a part of (see Table 5.11.4).

Table 5.11.4 Endpoints as a Function of Zone Group Mode

Endpoint	Occupied	Cooldown	Setup	Warmup	Setback	Unoccupied
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Vheat-max	0	0	Vheat-max	Vheat-max	0

E. Control logic is depicted schematically in Figures 5.11.5-1 and 5.11.5-2 and described in the following subsections.

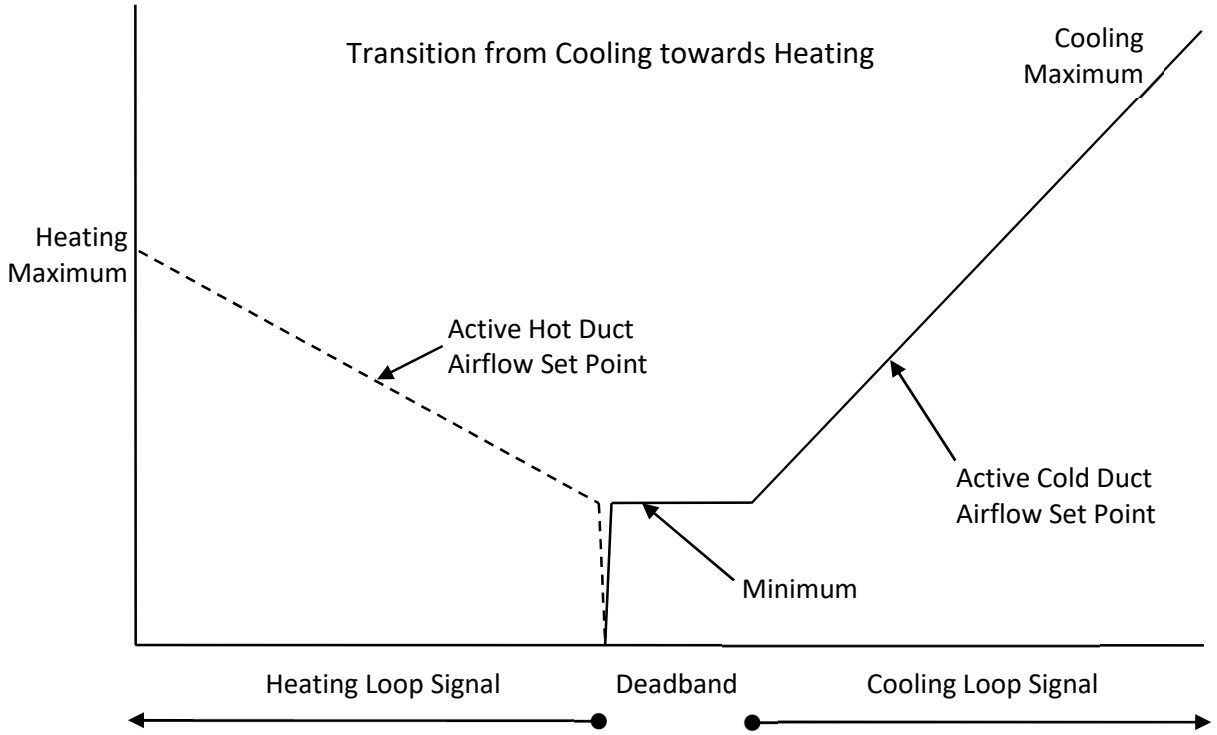


Figure 5.11.5-1 Control logic for snap-acting dual-duct VAV zone (transition from cooling towards heating).

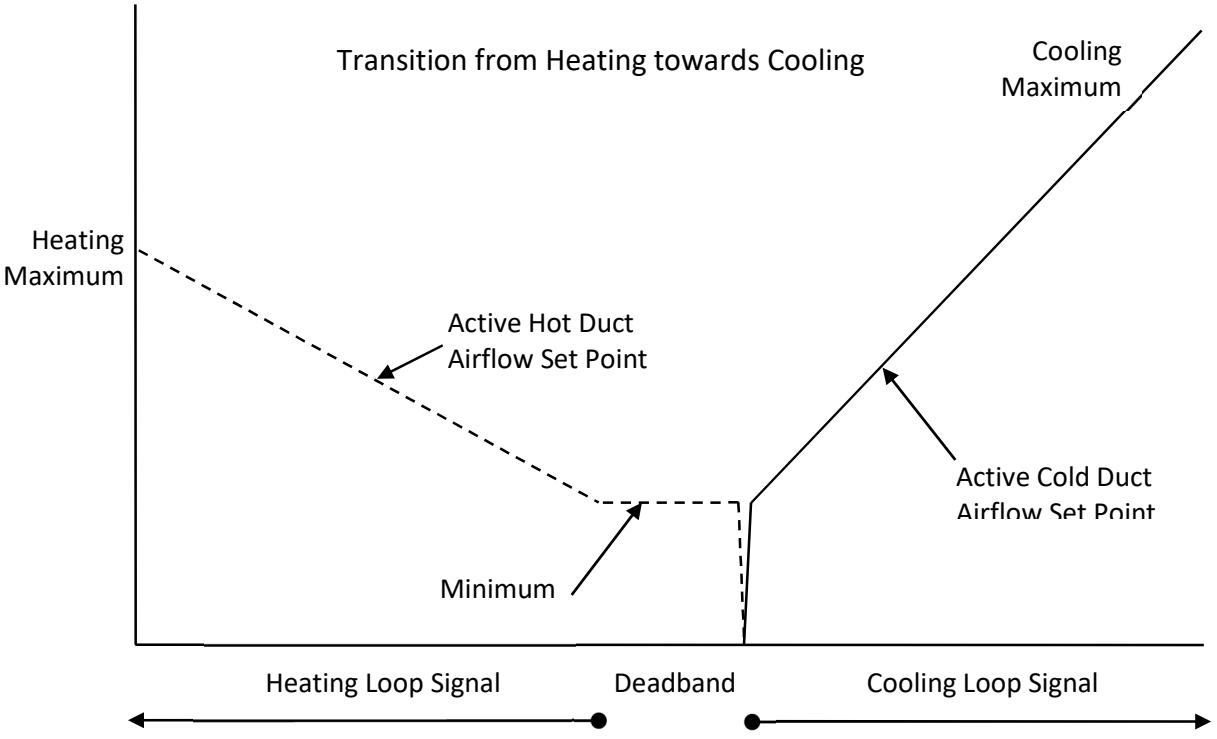


Figure 5.11.5-2 Control logic for snap-acting dual-duct VAV zone (transition from heating towards cooling).

1. Temperature and Damper Control with Dual Inlet Airflow Sensors

    a. When the Zone State is cooling, the cooling-loop output shall reset the active cold duct airflow setpoint from the minimum endpoint to cooling maximum endpoint. The cold duct damper shall be modulated by a control loop to maintain the measured cooling airflow at the active cold duct airflow setpoint. The hot duct damper shall be closed.

        1) If cold-deck supply air temperature from the air handler is greater than room temperature, the active cold duct airflow setpoint shall be no higher than the minimum endpoint.

    b. When the Zone State is deadband, the active cold duct and hot duct airflow setpoints shall be their last setpoints just before entering deadband. In other words, when going from cooling to deadband, the active cold duct airflow setpoint is equal to the minimum endpoint, and the active hot duct airflow setpoint is zero. When going from heating to deadband, the active hot duct airflow setpoint is equal to the minimum endpoint, and the active cold duct airflow setpoint is zero. This results in a snap-action switch in the damper setpoint as indicated in Figures 5.11.5-1 and 5.11.5-2.

    c. When the Zone State is heating, the heating-loop output shall reset the active hot duct airflow setpoint from the minimum endpoint to heating maximum endpoint. The hot duct damper shall be modulated by a control loop to maintain the measured heating airflow at the active hot duct airflow setpoint. The cold duct damper shall be closed.

        1) If hot-deck supply air temperature from the air handler is less than room temperature, the active hot duct airflow setpoint shall be no higher than the minimum endpoint.

2. Overriding Section 3.6E.1 Logic (to Avoid Backflow from One Duct to the Other)

    a. If heating air handler is not proven on, the heating damper shall be closed.

    b. If cooling air handler is not proven on, the cooling damper shall be closed.

F. Alarms

1. Low Airflow

    a. If the measured airflow is less than 70% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 4 alarm.

    b. If the measured airflow is less than 50% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 3 alarm.

c. If a zone has an Importance-Multiplier of 0 (see Section 3.1O.2.a.1)) for its static pressure reset T&R control loop, low airflow alarms shall be suppressed for that zone.

2. Airflow Sensor Calibration. If the fan serving the zone is off and airflow sensor reading is above the larger of 10% of the maximum airflow setpoint or 50 cfm for 30 minutes, generate a Level 3 alarm.

3. Leaking Damper. If the damper position is 0%, and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 10 minutes while the fan serving the damper is proven on, generate a Level 4 alarm.

G. Testing/Commissioning Overrides. Provide software switches that interlock to a system level point to

a. force zone airflow setpoint to zero,

b. force zone airflow setpoint to Vcool-max,

c. force zone airflow setpoint to Vmin,

d. force zone airflow setpoint to Vheat-max,

e. force cooling damper full closed/open,

f. force heating damper full closed/open, and

g. reset request-hours accumulator point to zero (provide one point for each reset type listed in the next section).

H. System Requests

1. Cooling SAT Reset Requests

a. If the zone temperature exceeds the zone's cooling setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 3 requests.

b. Else if the zone temperature exceeds the zone's cooling setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 2 requests.

c. Else if the Cooling Loop is greater than 95%, send 1 request until the Cooling Loop is less than 85%.

d. Else if the Cooling Loop is less than 95%, send 0 requests.

2. Cold-Duct Static Pressure Reset Requests

a. If the measured airflow is less than 50% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

b. Else if the measured airflow is less than 70% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

c. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

d. Else if the damper position is less than 95%, send 0 requests.

3. Heating SAT Reset Requests

a. If the zone temperature is below the zone's heating setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 3 requests.

b. Else if the zone temperature is below the zone's heating setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 2 requests.

c. Else if the Heating Loop is greater than 95%, send 1 request until the Heating Loop is less than 85%.

d. Else if the Heating Loop is less than 95%, send 0 requests

4. Hot-Duct Static Pressure Reset Requests

a. If the measured airflow is less than 50% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

b. Else if the measured airflow is less than 70% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

c. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

d. Else if the damper position is less than 95%, send 0 requests.

5. Heating-Fan Requests. Send the heating fan that serves the zone a heating-fan request as follows:

a. If the Heating Loop is greater than 15%, send 1 request until the Heating Loop is less than 1%.

b. Else if the Heating Loop is less than 15%, send 0 requests.

3.7 DUAL-DUCT VAV TERMINAL UNIT − MIXING CONTROL

A. See “Generic Thermal Zones” (Section 3.3C) for setpoints, loops, control modes, alarms, etc.

B. See “Generic Ventilation Zones” (Section 3.3) for calculation of zone minimum outdoor airflow.

C. See Section C.2.c for zone minimum airflow setpoint Vmin, zone maximum cooling airflow setpoint Vcool-max, and the zone maximum heating airflow setpoint Vheat-max.

D. Active endpoints used in the control logic depicted in Figure 5.12.5 shall vary depending on the mode of the Zone Group the zone is a part of (see Table 5.12.4).

Table 5.12.4 Endpoints as a Function of Zone Group Mode

Endpoint	Occupied	Cooldown	Setup	Warmup	Setback	Unoccupied
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Vheat-max	0	0	Vheat-max	Vheat-max	0

E. Control logic is depicted schematically in Figure 5.12.5 and described in the following sections.

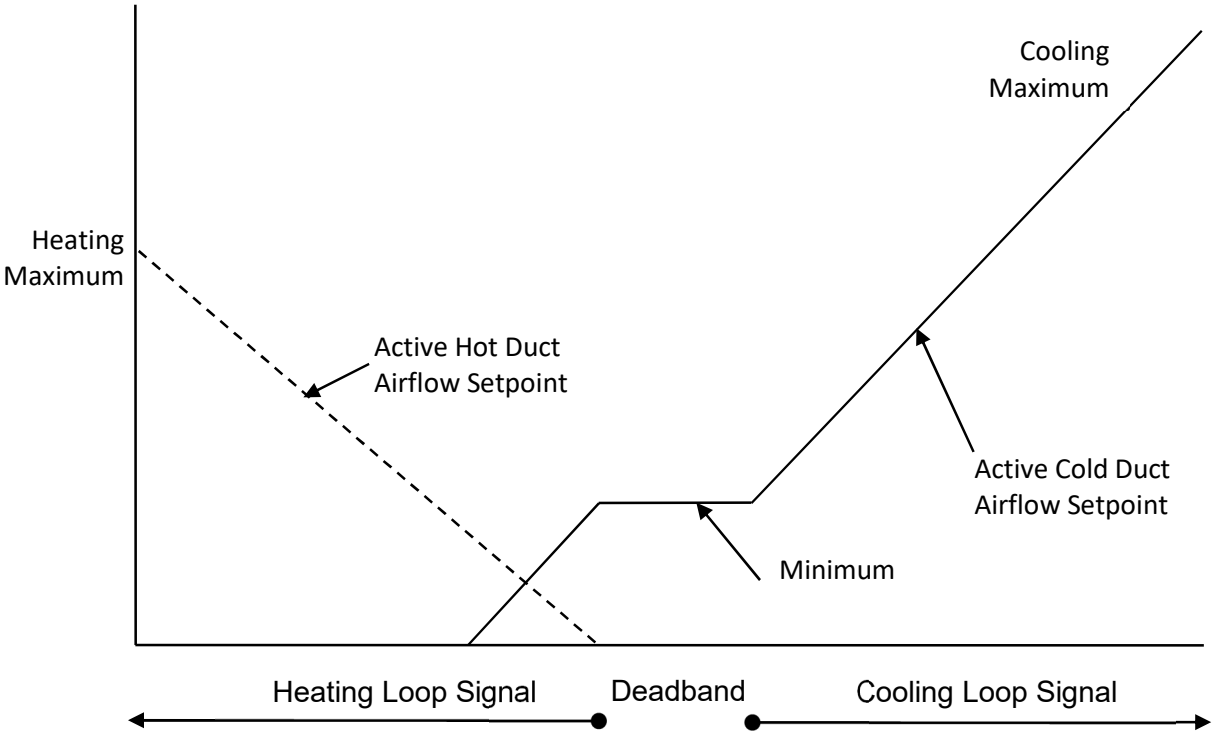


Figure 5.12.5 Control logic for mixing dual-duct VAV zone with inlet sensors.

1. Temperature Control

   a. When the Zone State is cooling, the Cooling Loop output shall reset the active cold duct airflow setpoint from minimum endpoint to the cooling maximum endpoint. The cold duct damper shall be modulated by a control loop to maintain the measured cold duct airflow at the active cold duct airflow setpoint.

      1) If cold duct supply air temperature from the air handler is greater than room temperature, the active cold duct supply airflow setpoint shall be no higher than the minimum endpoint.

   b. When the Zone State is deadband, the active cold duct airflow setpoint shall be the minimum endpoint. The cold duct damper shall be modulated by a control loop to maintain the measured cold duct airflow at the active cold duct airflow setpoint. The hot duct damper shall be closed.

   c. When the Zone State is heating, the heating-loop output shall reset the active hot duct airflow setpoint from zero to the heating maximum endpoint. The hot duct damper shall be modulated by a control loop to maintain the measured hot duct airflow at the active hot duct airflow setpoint. The cooling damper shall be controlled to maintain the sum of the measured inlet airflows at the minimum endpoint.

1) If hot-deck supply air temperature from air handler is less than room temperature, the active hot duct airflow setpoint shall be no higher than the minimum endpoint.

2. Overriding Section 1 Logic (to Avoid Backflow from One Duct to the Other)

a. If heating air handler is not proven on, the heating damper shall be closed.

b. If cooling air handler is not proven on, the cooling damper shall be closed.

F. Alarms

1. Low Airflow

a. If the measured airflow is less than 70% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 4 alarm.

b. If the measured airflow is less than 50% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 4 alarm.

c. If a zone has an Importance-Multiplier of 0 (see Section 3.1O.2.a.1)) for its static pressure reset T&R control loop, low airflow alarms shall be suppressed for that zone.

2. Airflow Sensor Calibration. If the fan serving the zone is off and airflow sensor reading is above the larger of 10% of the maximum airflow setpoint or 50 cfm for 30 minutes, generate a Level 3 alarm.

3. Leaking Damper. If the damper position is 0%, and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 10 minutes while the fan serving the damper is proven on, generate a Level 4 alarm.

G. Testing/Commissioning Overrides. Provide software switches that interlock to a system level point to

a. force zone airflow setpoint to zero,

b. force zone airflow setpoint to Vcool-max,

c. force zone airflow setpoint to Vmin,

d. force zone airflow setpoint to Vheat-max,

e. force cooling damper full closed/open,

f. force heating damper full closed/open, and

g. reset request-hours accumulator point to zero (provide one point for each reset type listed in the next section).

H. System Requests

1. Cooling SAT Reset Requests

   a. If the zone temperature exceeds the zone's cooling setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 3 requests.

   b. Else if the zone temperature exceeds the zone's cooling setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 2 requests.

   c. Else if the Cooling Loop is greater than 95%, send 1 request until the Cooling Loop is less than 85%.

   d. Else if the Cooling Loop is less than 95%, send 0 requests.

2. Cold-Duct Static Pressure Reset Requests

   a. If the measured airflow is less than 50% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

   b. Else if the measured airflow is less than 70% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

   c. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

   d. Else if the damper position is less than 95%, send 0 requests.

3. Heating SAT Reset Requests

   a. If the zone temperature is below the zone's heating setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 3 requests.

   b. Else if the zone temperature is below the zone's heating setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 2 requests.

   c. Else if the Heating Loop is greater than 95%, send 1 request until the Heating Loop is less than 85%.

   d. Else if the Heating Loop is less than 95%, send 0 requests.

4. Hot-Duct Static Pressure Reset Requests

a. If the measured airflow is less than 50% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

b. Else if the measured airflow is less than 70% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

c. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

d. Else if the damper position is less than 95%, send 0 requests.

5. Heating-Fan Requests. Send the heating fan that serves the zone a heating-fan request as follows:

a. If the Heating Loop is greater than 15%, send 1 request until the Heating Loop is less than 1%.

b. Else if the Heating Loop is less than 15%, send 0 requests.

3.8 AIR-HANDLING UNIT SYSTEM MODES

A. AHU system modes are the same as the mode of the Zone Group served by the system. When Zone Group served by an air-handling system are in different modes, the following hierarchy applies (highest one sets AHU mode):

a. Occupied Mode

b. Cooldown Mode

c. Setup Mode

d. Warmup Mode

e. Setback Mode

f. Unoccupied Mode

3.9 DUAL-FAN DUAL-DUCT COOLING AIR HANDLER

A. Supply Fan Control

1. Supply Fan Start/Stop

a. Supply fan shall run when system is in the Cooldown Mode, Setup Mode, or Occupied Mode.

b. Totalize current airflow rate from VAV boxes to a software point Vps.

VAV box airflow rates are summed to obtain overall supply air rate without the need for an airflow measuring station (AFMS) at the air-handler discharge. This is used for ventilation rate calculations and may also be used for display and diagnostics.

2. Static Pressure Set-Point Reset

   a. Static pressure setpoint. Setpoint shall be reset using T&R logic (see Section 3.1O) using the parameters shown in Table 5.16.1.2.

Table 5.16.1.2 Trim & Respond Variables

Variable	Value
Device	Supply fan
SP0	120 Pa (0.5 in. of water)
SPmin	25 Pa (0.1 in. of water)
SPmax	Max_DSP (see Section 1.3B.1)
Td	10 minutes
T	2 minutes
I	2
R	Zone static pressure reset requests
SPtrim	–12 Pa (–0.05 in. of water)
SPres	15 Pa (+0.06 in. of water)
SPres-max	32 Pa (+0.13 in. of water)

The T&R reset parameters in Table 5.16.1.2 are suggested as a starting point; they will most likely require adjustment during the commissioning/tuning phase.

3. Static Pressure Control

   a. Supply fan speed is controlled to maintain DSP at setpoint when the fan is proven on. Where the Zone Groups served by the system are small, provide multiple sets of gains that are used in the control loop as a function of a load indicator (such as supply-fan airflow rate, the area of the Zone Groups that are occupied, etc.).

High-pressure trips may occur if all VAV boxes are closed (as in Unoccupied Mode) or if fire/smoke dampers are closed (in some fire/smoke damper (FSD) designs, the dampers are interlocked to the fan status rather than being controlled by smoke detectors). Multiple sets of gains are used to provide control loop stability as system characteristics change.

B. Supply Air Temperature Control

1. Control loop is enabled when the supply air fan is proven on, and disabled and output set to deadband (no heating, minimum economizer) otherwise.

2. Supply Air Temperature Setpoint

The default range of outdoor air temperatures [21°C (70°F) –16°C (60°F)] used to reset the Occupied Mode SAT setpoint was chosen to maximize economizer hours. It may be preferable to use a lower range of OATs (e.g., 18°C [65°F] – 13°C [55°F]) to minimize fan energy if there is a 24/7 chiller plant that is running anyway; reheat is minimized, as in a VAV dual-fan dual-duct system, or the climate severely limits the number of available economizer hours.
If using this logic, the engineer should oversize interior zones and rooms with high cooling loads (design them to be satisfied by the warmest SAT) so these zones do not drive the T&R block to the minimum SAT setpoint.

   a. See Section 1.2E.1 for Min_ClgSAT, Max_ClgSAT, OAT_Min, and OAT_Max setpoints.

   b. During Occupied Mode and Setup Mode, setpoint shall be reset from Min_ClgSAT when the outdoor air temperature is OAT_Max and above, proportionally up to T-max when the outdoor air temperature is OAT_Min and below.

      1) T-max shall be reset using T&R logic (see Section 3.1O) between Min_ClgSAT and Max_ClgSAT. The parameters shown in Table 5.16.2.2 are suggested as a starting place, but they will require adjustment during the commissioning/tuning phase.

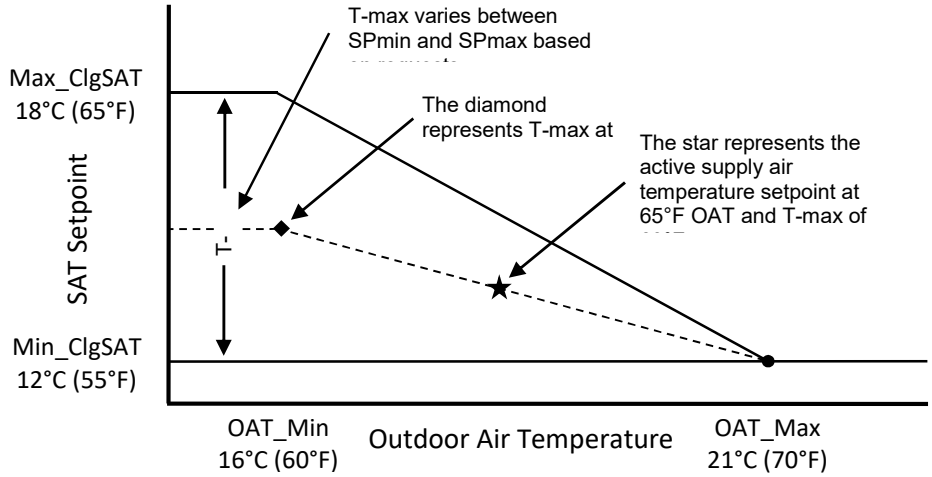
The T&R reset parameters in Table 5.16.2.2 are suggested as a starting place; they will most likely require adjustment during the commissioning/tuning phase.

Table 5.16.2.2 Trim & Respond Variables

Variable	Value
Device	Supply fan
SP0	SPmax
SPmin	Min_ClgSAT
SPmax	Max_ClgSAT
Td	10 minutes
T	2 minutes
I	2
R	Zone cooling SAT requests

SPtrim	+0.1°C (+0.2°F)
SPres	–0.2°C (–0.3°F)
SPres-max	–0.6°C (–1.0°F)

The net result of this SAT reset strategy is depicted in the Figure 5.16.2.2 for Min_ClgSAT = 12°C (55°F), Max_ClgSAT = 18°C (65°F), OAT_Max = 21°C (70°F), and OAT_Min = 16°C (60°F).



Informative Figure 5.16.2.2 Example supply air temperature reset diagram.

c. During Cooldown Mode, setpoint shall be Min_ClgSAT.

3. Supply air temperature shall be controlled to setpoint using a control loop whose output is mapped to sequence the hot water supply temperature, outdoor air damper, return air damper, and chilled water supply temperature as shown in Figure 5.16.2.3.

   a. When switching from Heating Mode to Cooling Mode and vice versa, wait the longer of the nominal timing of the changeover valve and 5 minutes (adj.) since the 2-way control valve was last shut prior to releasing the control valve to open (the intent of this logic is twofold: to avoid sending chilled water into the hot water system before the changeover valve is fully indexed, and to give the fluid trapped in the coil time to reach neutral temperature before being passed to the other loop).

   b. Control valve output action shall be direct-acting when in Cooling Mode and reverse acting when in heating mode.

   c. For units with relief dampers or relief fans

1) Economizer damper minimum position MinOA-P and/or return air damper maximum position MaxRA-P are modulated to control minimum outdoor air volume (see Sections 3.9D.3, 3.9E.3 and 3.9F.2).

For units with a separate minimum outdoor air damper, economizer damper minimum position MinOA-P is 0%, and return air damper maximum position MaxRA-P is modulated to control minimum outdoor air volume (see Sections 3.9D and 3.9E).

3) For units with a single common minimum outdoor air and economizer damper, return air damper maximum position MaxRA-P and economizer damper minimum position MinOA-P are modulated to control minimum outdoor air volume (see Section 3.9F). Economizer damper maximum position MaxOA-P is limited during minimum outdoor air control (e.g., economizer lockout due to high OAT).

d. The points of transition along the x-axis shown and described in Figure 5.16.2.3 are representative. Separate gains shall be provided for each section of the control map (heating coil, economizer, cooling coil) that is determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown in Figure 5.16.2.3 to provide stable control. Damper control depends on the type of building pressure control system.

For AHUs with relief fans, outdoor air and return air dampers are sequenced rather than complementary (as per traditional sequences) to reduce fan power at part loads.

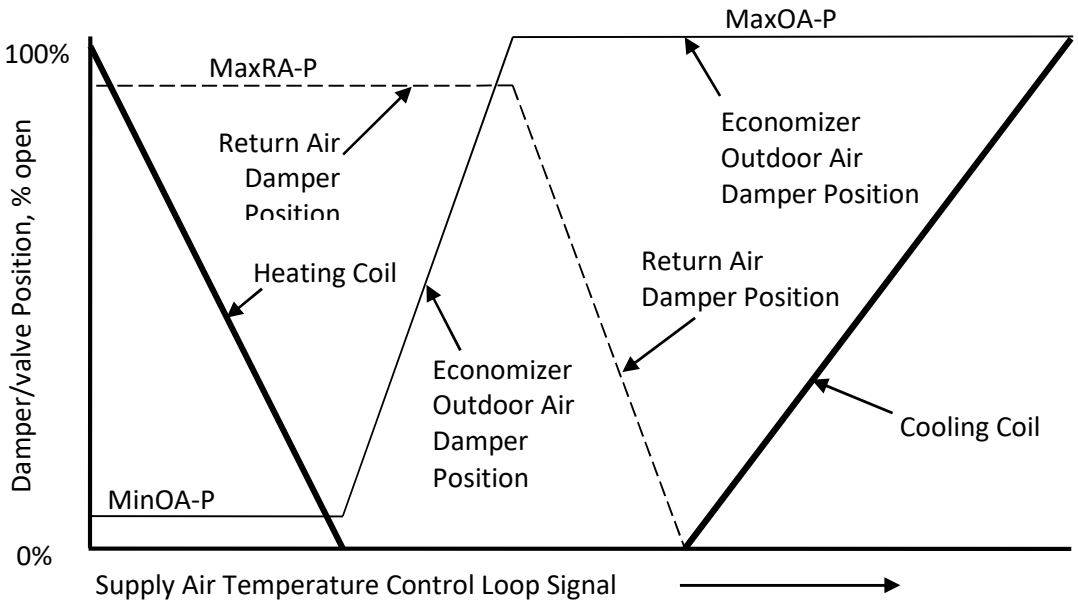


Figure 5.16.2.3 SAT loop mapping with relief damper or relief fan.

C. Minimum Outdoor Airflow Setpoints

1. Outdoor Airflow Setpoint for California Title 24 Ventilation

   a. See Section 3.3A.3 for zone outdoor air rates Zone-Abs-OA-min and Zone-Des-OA-min.

   b. See Section 1.2E.2.a for setpoints AbsMinOA and DesMinOA.

   c. Effective outdoor air absolute minimum and design minimum setpoints are recalculated continuously based on the mode of the zones being served.

      1) AbsMinOA* is the sum of Zone-Abs-OA-min for all zones in all Zone Groups that are in Occupied Mode but shall be no larger than the absolute minimum outdoor airflow AbsMinOA.

      2) DesMinOA* is the sum of Zone-Des-OA-min for all zones in all Zone Groups that are in Occupied Mode but shall be no larger than the design minimum outdoor airflow DesMinOA.

D. Minimum Outdoor Air Control with a Separate Minimum Outdoor Air Damper and Differential Pressure Control

1. DP setpoint for California Title 24 Ventilation

   a. See Section 1.1.1.1.a for design OA DP setpoints.

   b. See Section 3.9C.1 for calculation of current setpoints AbsMinOA* and DesMinOA*.

   c. See zone CO2 control logic under terminal unit sequences.

   d. The active minimum DP setpoints AbsDPsp* and DesDPsp* shall be determined by the following equations:

$$\text{AbsDPsp}^* = \text{AbsMinDP}\left[\frac{\text{AbsMinOA}^*}{\text{AbsMinOA}}\right]^2$$

$$\text{DesDPsp}^* = \text{DesMinDP}\left[\frac{\text{DesMinOA}^*}{\text{DesMinOA}}\right]^2$$

This equation prevents excess outdoor air from being supplied during periods of partial occupancy.

   e. The minimum outdoor air DP setpoint MinDPsp shall be reset based on the highest zone CO2 control-loop signal from AbsDPsp* at 50% signal to DesDPsp* at 100% signal.

   f. The minimum outdoor air setpoint MinOAsp shall be reset based on the highest zone CO2 control-loop signal from AbsMinOA* at 50% signal to DesMinOA* at 100% signal.

2. Open minimum outdoor air damper when the supply air fan is proven on and the system is in Occupied Mode and MinDPsp is greater than zero. Damper shall be closed otherwise.

3. Outdoor Air and Return Air Dampers

   a. For units with relief dampers or relief fans

Minimum outdoor air control is enabled when economizer damper position is less than MOA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
Minimum outdoor air control is disabled when return damper position is less than MRA-P, because the economizer damper has been closed to enable an accurate airflow measurement through the minimum outdoor air damper.
The 20% and 80% thresholds can be increased/decreased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1) When the supply air fan is proven on and the system is in Occupied Mode and MinDPsp is greater than zero, the system shall calculate MOA-P. The value of MOA-P shall scale from 5% when supply-fan speed is at 100% design speed proportionally up to 80% when the fan is at minimum speed. When MOA-P is not being calculated for any reason, it shall be set to 0%.

2) When the supply air fan is proven on and the system is in Occupied Mode and MinDPsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

3) Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

   a) The economizer high limit conditions in Section 3.1Q are exceeded.

   b) When the minimum outdoor air damper is open and the economizer outdoor air damper position is less than MOA-P.

4) When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section 3.9B shall be suspended per the following sequence:

   a) Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

b) Wait 15 seconds, then close the economizer outdoor air damper; and

c) Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section 3.9B. Economizer outdoor air damper remains closed.

d) The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain DP across the minimum outdoor air damper at setpoint MinDPsp.

5) Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

a) The economizer high limit conditions in Section 3.1Q are not exceeded.

b) The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

6) When minimum outdoor air control is disabled:

a) MaxRA-P shall be set to 100%.

b) Economizer and return air damper positions shall be controlled by the SAT control loop per Section 3.9B.

E. Minimum Outdoor Air Control with a Separate Minimum Outdoor Air Damper and Airflow Measurement

1. Outdoor Airflow Setpoint for California Title 24 Ventilation

a. See Section 3.9C.1 for calculation of current setpoints AbsMinOA* and DesMinOA*.

b. See zone CO2 control logic under terminal unit sequences.

c. The minimum outdoor air setpoint MinOAsp shall be reset based on the highest zone CO2 control-loop signal from AbsMinOA* at 50% signal to DesMinOA* at 100% signal.

2. Open the minimum outdoor air damper when the supply fan is proven ON, the AHU is in Occupied Mode and MinOAsp is greater than zero. Minimum outdoor air damper shall be closed otherwise.

3. Outdoor Air and Return Air Dampers

a. For units with return fans

Minimum outdoor air control is enabled when return damper position exceeds MRA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
The 20% threshold can be increased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1) When the supply air fan is proven on and the system is in Occupied Mode and MinOAsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

2) Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

   a) The economizer high limit conditions in Section 3.1Q are exceeded.

   b) When the minimum outdoor air damper is open and the return air damper position is greater than MRA-P.

3) When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section B shall be suspended per the following sequence:

   a) Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

   b) Wait 15 seconds, then close the economizer outdoor air damper; and

   c) Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section B. Economizer outdoor air damper remains closed.

   d) The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain airflow across the minimum outdoor air damper at setpoint MinOAsp.

4) Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

   a) The economizer high limit conditions in Section 3.1Q are exceeded.

b) The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

5) When minimum outdoor air control is disabled:

a) Economizer outdoor air damper shall be fully opened.

b) MaxRA-P shall be set to 100%.

c) Economizer and return air damper positions shall be controlled by the SAT control loop per Section B.

b. For units with relief dampers or relief fans

Minimum outdoor air control is enabled when economizer damper position is less than MOA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
Minimum outdoor air control is disabled when return damper position is less than MRA-P, because the economizer damper has been closed to enable an accurate airflow measurement through the minimum outdoor air damper.
The 20% and 80% thresholds can be increased/decreased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1) When the supply air fan is proven on and the system is in occupied mode and MinOAsp is greater than zero, the system shall calculate MOA-P. The value of MOA-P shall scale from 5% when supply-fan speed is at 100% design speed proportionally up to 80% when the fan is at minimum speed. When MOA-P is not being calculated for any reason, it shall be set to 0%.

2) When the supply air fan is proven on and the system is in occupied mode and MinOAsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

3) Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

a) The economizer high limit conditions in Section 3.1Q are exceeded.

b) When the minimum outdoor air damper is open and the economizer outdoor air damper position is less than MOA-P.

4) When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section B shall be superseded per the following:

a) Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

b) Wait 15 seconds, then close the economizer outdoor air damper; and

c) Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section B. Economizer outdoor air damper remains closed.

d) The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain airflow across the minimum outdoor air damper at setpoint MinOAsp.

5) Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

a) The economizer high limit conditions in Section 3.1Q are not exceeded.

b) The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

6) When minimum outdoor air control is disabled:

a) MaxRA-P shall be set to 100%.

b) Economizer and return air damper positions shall be controlled by the SAT control loop per Section B.

F. Minimum Outdoor Air Control with a Single Common Damper for Minimum Outdoor Air and Economizer Functions and Airflow Measurement

1. Outdoor Airflow Setpoint for California Title 24 Ventilation

a. See Section 3.9C.1 for calculation of current setpoints AbsMinOA* and DesMinOA*.

b. See zone CO2 control logic under terminal unit sequences.

c. The minimum outdoor air setpoint MinOAsp shall be reset based on the highest zone CO2 control-loop signal from AbsMinOA* at 50% signal to DesMinOA* at 100% signal.

2. Minimum Outdoor Air Control Loop

   a. Minimum outdoor air control loop is enabled when the supply fan is proven on and the AHU is in Occupied Mode, and disabled and output set to zero otherwise.

   b. For units with return fans:

The following logic limits the return damper position to ensure that minimum outdoor air is maintained at all times, while the actual return damper position is modulated by the SAT control loop.

      1) The outdoor airflow rate shall be maintained at the minimum outdoor damper outdoor airflow setpoint MinOAsp by a direct-acting control loop whose output is mapped to the return air damper maximum position endpoint MaxRA-P.

The following logic directly controls the return damper position to ensure that exactly the minimum outdoor air – and no more – is provided when economizer lockout conditions are exceeded. When economizer lockout no longer applies, return damper control reverts to the SAT control loop.

      2) While the unit is in Occupied Mode, if the economizer high limit conditions in Section 3.1Q are exceeded for 10 minutes, outdoor air shall be controlled to the minimum outdoor airflow. When this occurs, the normal sequencing of the return air damper by the SAT control loop is suspended, and the return air damper position shall be modulated directly to maintain measured airflow at MinOAsp (i.e. return damper position shall equal MaxRA-P). The economizer damper shall remain open.

      3) If the economizer high limit conditions in Section 3.1Q are not exceeded for 10 minutes, or the unit is no longer in Occupied Mode, release return damper to control by the SAT control loop (i.e. return damper position is limited by MaxRA-P endpoint, but is not directly controlled to equal MaxRA-P).

   c. For units with relief dampers or relief fans:

The following logic limits the return and economizer damper positions to ensure that minimum outdoor air is maintained at all times, while the actual damper positions are modulated by the SAT control loop.

      1) The outdoor airflow rate shall be maintained at the minimum outdoor air setpoint MinOAsp by a reverse-acting control loop whose output is mapped to economizer damper minimum position MinOA-P and return air damper maximum position MaxRA-P as indicated in Figure 5.16.6.3.

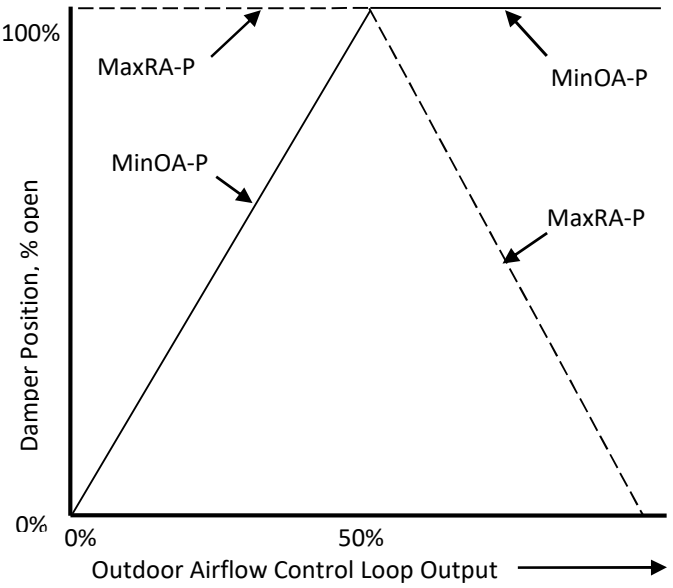


Figure 5.16.6.3 Minimum outdoor airflow control mapping with single damper.

The following logic directly controls the return and economizer damper positions to ensure that exactly the minimum outdoor air – and no more – is provided when economizer lockout conditions are exceeded. When economizer lockout no longer applies, return damper control reverts to the SAT control loop.

2) While the unit is in Occupied Mode, if the economizer high limit conditions in Section 3.1Q are exceeded for 10 minutes, outdoor airflow shall be controlled to the minimum outdoor airflow setpoint, MinOAsp. When this occurs, the normal sequencing of the return air damper by the SAT control loop is suspended as follows:

   a) Fully open the return air damper

   b) Wait 15 seconds, then set MaxOA-P equal to MinOA-P

   c) Wait 3 minutes, then modulate the return air damper to maintain the measured airflow at MinOAsp (i.e. return air damper position shall equal MaxRA-P).

3) If the economizer high limit conditions in Section 3.1Q are not exceeded for 10 minutes, or the unit is no longer in Occupied Mode, set MaxOA-P = 100% and release the return air damper to control by the SAT control loop (i.e. return air damper position is limited by the MaxRA-P endpoint, but is not directly controlled to equal MaxRA-P).

G. Relief-Fan Control

A pressure zone is defined as an enclosed area with interconnected return paths. The appropriate boundaries for pressure zones, establishing which relief fans run together and which building pressure sensors are used, will need to be determined by the engineer based on building geometry.
Relief fans are enabled and disabled with their associated supply fans, but all relief fans that are running and serve a pressure zone run at the same speed. All operating relief fans that serve a pressure zone shall be controlled as if they were one system, running at the same speed and using the same control loop, even if they are associated with different AHUs. For example, if two AHUs share a pressure zone, their relief fans should be controlled together as one system, while both AHUs are operating.
This prevents relief fans from fighting each other, which can lead to flow reversal or unstable fan speed control and space pressurization problems.
The appropriate boundaries between relief systems, establishing which relief fans run together, will need to be determined by the engineer based on building geometry.

1. See Section **Error! Reference source not found.** for pressure Zone Group assignments.

2. Relief fans or relief fan VFD Fan groups shall be lead/lag controlled per Paragraph 3.1P.

3. All operating relief fans that serve a pressure zone shall be grouped and controlled as if they were one system, running at the same speed when enabled and using the same control loop, even if they are associated with different AHUs.

4. A relief fan shall be enabled when its associated supply fan is proven on, and shall be disabled otherwise.

5. Building static pressure shall be time averaged with a sliding 5-minute window and 15 second sampling rate (to dampen fluctuations). The averaged value shall be that displayed and used for control.

    a. Where multiple building pressure sensors are used, each shall be time-averaged and the highest of the averaged values for sensors within a pressure zone shall be used for control.

6. A single P-only control loop for each pressure zone shall maintains the building pressure at a setpoint of 12 Pa (0.05 in. of water) with an output ranging from 0% to 100%. The loop shall be enabled when any supply fan within the pressure zone is proven ON. The loop is disabled with output set to zero otherwise.

The following is intended to use barometric relief as the first stage and then maintain many fans on at low speed to minimize noise and reduce losses through discharge dampers and louvers. Fans are staged off only when running at minimum speed. For best results, fan speed minimums should be set as low as possible.

7. Fan speed signal to all operating fans in the relief system group shall be the same and shall be equal to the PID signal but no less than the minimum speed.

Except for Stage 0, discharge dampers of all relief fans shall be open only when fan is commanded on.

In some installations, the relief fan inlet plenum may also be the return plenum to the AHU mixed air plenum, in which case the pressure in this plenum may be drawn negative relative to the outdoors by the supply air fan drawing return air from this plenum. This can occur when the return path has a fairly high pressure drop. If the engineer is concerned that this may occur, Stage 0 and references to it should be deleted.

a. Stage 0 (barometric relief). When relief system is enabled, and the control loop output is above 5%, open the motorized dampers to all relief fans serving the relief system group that are enabled; close the dampers when the loop output drops to 0% for 5 minutes.

b. Stage Up. When control loop is above minimum speed plus 15%, start stage-up timer. Each time the timer reaches 7 minutes, start the next relief fan (and open the associated damper) in the relief system group, per staging order, and reset the timer to 0. The timer is reset to 0 and frozen if control loop is below minimum speed plus 15%.

1) For systems where relief fans share a common relief fan inlet plenum: When staging from Stage 0 (no relief fans) to Stage 1 (one relief fan), the relief dampers of all nonoperating relief fans must be closed.

2) For systems where relief fans do not share a common relief fan inlet plenum: When staging from Stage 0 (no relief fans) to Stage 1 (one relief fan), the discharge dampers of all nonoperating relief fans shall remain open when the associated supply fan is proven ON.

c. Stage Down. When PID loop is below minimum speed, start stage-down timer. Each time the timer reaches 5 minutes, shut off lag fan per staging order and reset the timer to 0. The timer is reset to 0 and frozen if PID loop rises above minimum speed or all fans are off. If all fans are off, go to Stage 0 (all dampers open and all fans off).

8. For fans in a Level 2 alarm and status is off, discharge damper shall be closed when stage is above Stage 0.

Freeze protection logic was deleted since it is buggy and not needed in Bay Area.

H. Alarms

1. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 4. Reset interval count when alarm is acknowledged.

2. Fan alarm is indicated by the status being different from the command for a period of 15 seconds.

a. Commanded on, status off: Level 2

b. Commanded off, status on: Level 4

3. Filter pressure drop exceeds the larger of the alarm limit or 12.5 Pa (0.05") for 10 minutes when airflow (expressed as a percentage of design airflow or design speed if total airflow is not known) exceeds 20%: Level 4. The alarm limit shall vary with total airflow (if available; use fan speed if total airflow is not known) as follows:

$$DP_x = DP_{100}(x)^{1.4}$$

where DP100 is the high-limit pressure drop at design airflow (determine limit from filter manufacturer) and DPx is the high limit at the current airflow rate x (expressed as a fraction). For instance, the setpoint at 50% of design airflow would be (0.5)1.4, or 38% of the design high-limit pressure drop. See Section 1.2E.4 for DP100.

The constant value threshold for the filter pressure drop alarm is a function of the transducer and A/D converter used to measure filter differential pressure. The value used shall be determined as the minimum accuracy of the transducer and A/D converter combination.

4. High building pressure (more than 25 Pa [0.10 in. of water]) for 5 minutes: Level 3.

5. Low building pressure (less than 0 Pa [0.0 in. of water], i.e., negative) for 5 minutes: Level 4.

Automatic fault detection and diagnostics (AFDD) is a sophisticated system for detecting and diagnosing air-handler faults.
To function correctly, AFDD requires specific sensors and data be available, as detailed in the sequences below. If this information is not available, AFDD tests that do not apply should be deleted.

I. Automatic Fault Detection and Diagnostics

The AFDD routines for AHUs continually assess AHU performance by comparing the values of BAS inputs and outputs to a subset of potential fault conditions. The subset of potential fault conditions that is assessed at any point depends on the operating state (OS) of the AHU, as determined by the position of the cooling and heating valves and the economizer damper. Time delays are applied to the evaluation and reporting of fault conditions to suppress false alarms. Fault conditions that pass these filters are reported to the building operator along with a series of possible causes.
These equations assume that the air handler is equipped with hydronic heating and cooling coils, as well as a fully integrated economizer. If any of these components are not present, the associated tests and variables should be omitted from the programming.
Note that these alarms rely on reasonably accurate measurement of mixed air temperature. An MAT sensor is required for many of these alarms to work, and an averaging sensor is strongly recommended for best accuracy.

1. AFDD conditions are evaluated continuously and separately for each operating AHU.

2. For units with return fans:

   a. The OS of each Ahu shall be defined by the commanded positions of the heating coil control valve, cooling coil control valve and the return air damper in accordance with Table 2.

Table 2 VAV AHU Operating States

Operating State	Heating Valve Position	Cooling Valve Position	Return Air Damper Position
#1: Heating	> 0	= 0	= MaxRA-P
#2: Free cooling, modulating OA	= 0	= 0	MaxRA-P > x > 0%
#3: Mechanical + economizer cooling	= 0	> 0	= 0%
#4: Mechanical cooling, minimum OA	= 0	> 0	= MaxRA-P
#5: Unknown or dehumidification	No other OS applies		

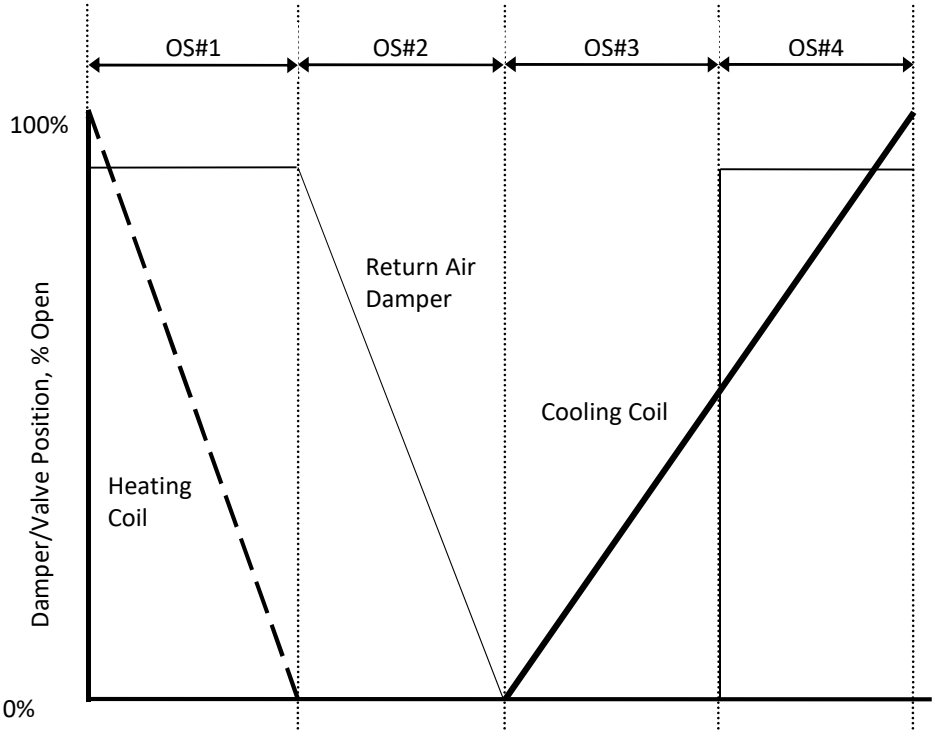


Figure 2 VAV AHU operating states.

3. For units with relief dampers or relief fans and a separate minimum outdoor air damper:

   a. The OS of each AHU shall be defined by the commanded positions of the heating-coil control valve, cooling-coil control valve, and economizer damper in accordance with Table 3 and Figure 3.

Table 3 VAV AHU Operating States

Operating State	Heating Valve Position	Cooling Valve Position	Economizer Outdoor Air Damper Position
#1: Heating	> 0	= 0	= 0%
#2: Free cooling, modulating OA	= 0	= 0	0% < x < 100%
#3: Mechanical + economizer cooling	= 0	> 0	= 100%
#4: Mechanical cooling, minimum OA	= 0	> 0	= 0%
#5: Unknown or dehumidification	No other OS applies		

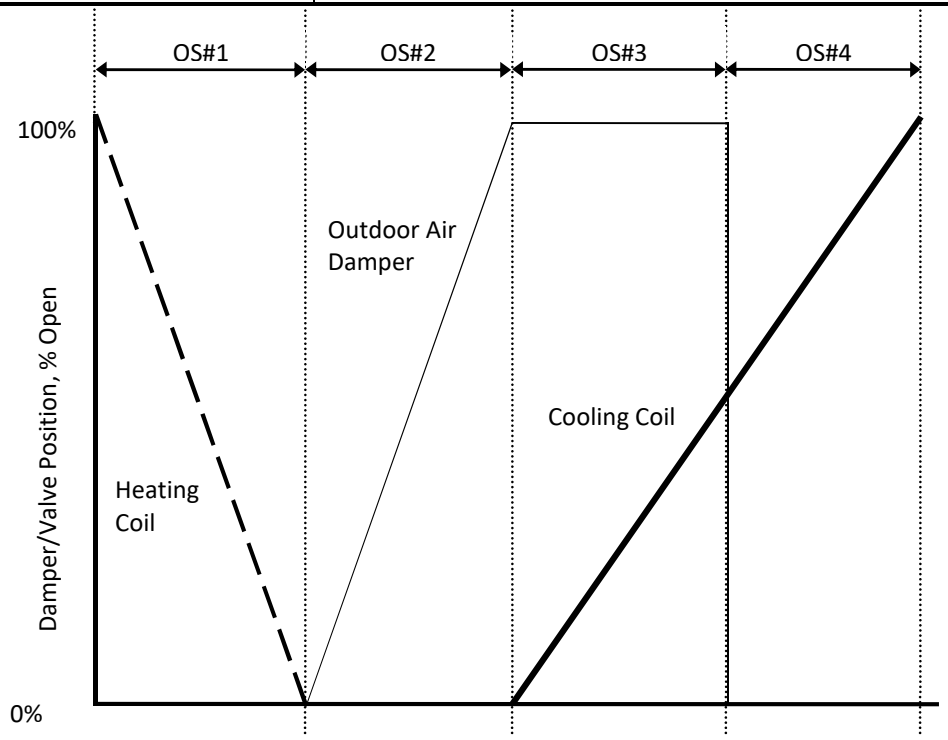


Figure 3 VAV AHU operating states.

4. For units with relief dampers or relief fans and a single common damper of minimum outdoor air and economizer functions.

   a. The OS of each AHU shall be defined by the commanded positions of the heating-coil control valve, cooling-coil control valve, and economizer damper in accordance with Table 4 and Figure 4.

Table 4 VAV AHU Operating States

Operating State	Heating Valve Position	Cooling Valve Position	Outdoor Air Damper Position
#1: Heating	> 0	= 0	= MinOA-P
#2: Free cooling, modulating OA	= 0	= 0	MinOA-P < x < 100%
#3: Mechanical + economizer cooling	= 0	> 0	= 100%
#4: Mechanical cooling, minimum OA	= 0	> 0	= MinOA-P
#5: Unknown or dehumidification	No other OS applies		

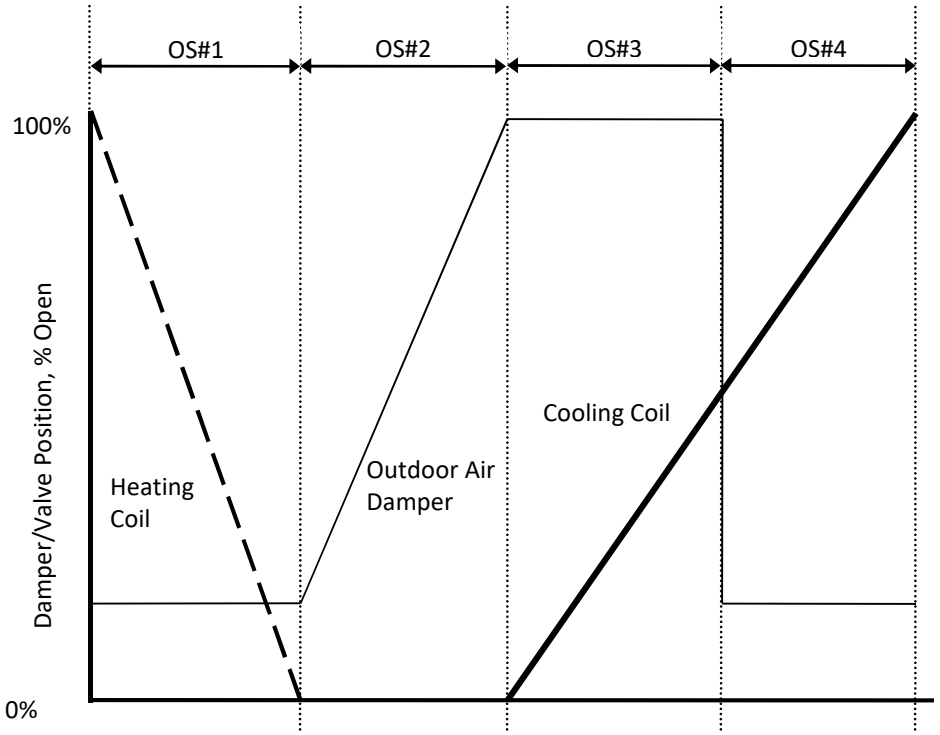


Figure 4 VAV AHU operating states.

The OS is distinct from, and should not be confused with, the zone status (cooling, heating, deadband) or Zone Group mode (occupied, warmup, etc.).
OS#1 through OS#4 (see Tables 2 through 4) represent normal operation during which a fault may nevertheless occur if so determined by the fault condition tests in Section 8. By contrast, OS#5 may represent an abnormal or incorrect condition (such as simultaneous heating and cooling) arising from a controller failure or programming

error, but it may also occur normally, e.g., when dehumidification is active or during warmup.

5. The following points must be available to the AFDD routines for each AHU:

For the AFDD routines to be effective, an averaging sensor is recommended for SAT. An averaging sensor is essential for MAT, as the environment of the mixing box will be subject to nonuniform and fluctuating air temperatures. It is recommended that the OAT sensor be located at the AHU so that it accurately represents the temperature of the incoming air.

   a. SAT = supply air temperature

   b. MAT = mixed air temperature

   c. RAT = return air temperature

   d. OAT = outdoor air temperature

   e. DSP = duct static pressure

   f. SATSP = supply air temperature setpoint

   g. DSPSP = duct static pressure setpoint

   h. HC = heating-coil valve position command; 0% □ HC □ 100%

   i. CC = cooling-coil valve position command; 0% □ CC □ 100%

   j. FS = fan speed command; 0% □ FS □ 100%

   k. CCET = cooling-coil entering temperature (Depending on the AHU configuration, this could be the MAT or a separate sensor for this specific purpose.)

   l. CCLT = cooling-coil leaving temperature (Depending on the AHU configuration, this could be the SAT or a separate sensor for this specific purpose.)

   m. HCET = heating-coil entering temperature (Depending on the AHU configuration, this could be the MAT or a separate sensor for this specific purpose.)

   n. HCLT = heating-coil leaving temperature (Depending on the AHU configuration, this could be the SAT or a separate sensor for this specific purpose.)

6. The following values must be continuously calculated by the AFDD routines for each AHU:

a. Five-minute rolling averages with 1-minute sampling time of the following point values; operator shall have the ability to adjust the averaging window and sampling period for each point independently.

1) SATavg = rolling average of supply air temperature

2) MATavg = rolling average of mixed air temperature

3) RATavg = rolling average of return air temperature

4) OATavg = rolling average of outdoor air temperature

5) DSPavg = rolling average of duct static pressure

6) CCETavg = rolling average of cooling-coil entering temperature

7) CCLTavg = rolling average of cooling-coil leaving temperature

8) HCETavg = rolling average of heating-coil entering temperature

9) HCLTavg = rolling average of heating-coil leaving temperature

b. %OA = actual outdoor air fraction as a percentage = (MAT – RAT)/(OAT – RAT), or per airflow measurement station if available.

c. %OAmin = active minimum OA setpoint (MinOAsp) divided by actual total airflow (from sum of VAV box flows or by airflow measurement station) as a percentage.

d. OS = number of changes in operating state during the previous 60 minutes (moving window)

7. The internal variables shown in Table 5.16.14.5 shall be defined for each AHU. All parameters are adjustable by the operator, with initial values as shown.

Default values are derived from NISTIR 7365 and have been validated in field trials. They are expected to be appropriate for most circumstances, but individual installations may benefit from tuning to improve sensitivity and reduce false alarms.
The default values have been intentionally biased toward minimizing false alarms—if necessary, at the expense of missing real alarms. This avoids excessive false alarms that will erode user confidence and responsiveness. However, if the goal is to achieve the best possible energy performance and system operation, these values should be adjusted based on field measurement and operational experience.
Values for physical factors, such as fan heat, duct heat gain, and sensor error, can be measured in the field or derived from trend logs. Likewise, the occupancy delay and switch delays can be refined by observing in trend data the time required to achieve quasi steady-state operation.
Other factors can be tuned by observing false positives and false negatives (i.e., unreported faults). If transient conditions or noise cause false errors, increase the

alarm delay. Likewise, failure to report real faults can be addressed by adjusting the heating coil, cooling coil, temperature, or flow thresholds.

Table 7 VAV AHU AFDD Internal Variables

Variable Name	Description	Default Value
ΔTSF	Temperature rise across supply fan	1°C (2°F)
ΔTMIN	Minimum difference between OAT and RAT to evaluate economizer error conditions (FC#6)	6°C (10° F)
ℰSAT	Temperature error threshold for SAT sensor	1°C (2°F)
ℰRAT	Temperature error threshold for RAT sensor	1°C (2°F)
ℰMAT	Temperature error threshold for MAT sensor	3°C (5°F)
ℰOAT	Temperature error threshold for OAT sensor	1°C (2°F) if local sensor @ unit. 3°C (5°F) if global sensor.
ℰF	Airflow error threshold	30%
ℰVFDSPD	VFD speed error threshold	5%
ℰDSP	Duct static pressure error threshold	25 Pa (0.1")
ℰCCET	Cooling coil entering temperature sensor error. Equal to ℰMAT or dedicated sensor error	Varies, see Description
ℰCCLT	Cooling coil leaving temperature sensor error. Equal to ℰSAT or dedicated sensor error	
ℰHCET	Heating coil entering temperature sensor error; equal to ℰMAT or dedicated sensor error	
ℰHCLT	Heating coil leaving temperature sensor error. Equal to ℰSAT or dedicated sensor error	
ΔOSMAX	Maximum number of changes in Operating State during the previous 60 minutes (moving window)	7
ModeDelay	Time in minutes to suspend Fault Condition evaluation after a change in Mode	30
AlarmDelay	Time in minutes to that a Fault Condition must persist before triggering an alarm	30
TestModeDelay	Time in minutes that Test Mode is enabled	120

The purpose of ΔTmin is to ensure that the mixing box/economizer damper tests are meaningful. These tests are based on the relationship between supply, return, and outdoor air. If RAT ~ MAT, these tests will not be accurate and will produce false alarms.
The purpose of TestModeDelay is to ensure that normal fault reporting occurs after the testing and commissioning process is completed as prescribed in Section 14.

8. Table 8 shows potential fault conditions that can be evaluated by the AFDD routines. If the equation statement is true, then the specified fault condition exists. The fault conditions to be evaluated at any given time will depend on the OS of the AHU.

The equations in Table 8 assume that the SAT sensor is located downstream of the supply fan and the RAT sensor is located downstream of the return fan. If actual sensor locations differ from these assumptions, it may be necessary to add or delete fan heat correction factors.
To detect the required economizer faults in California Title 24 section 120.2(i)7, use FC#2, #3, and #5 through #13 at a minimum. Other Title 24 AFDD requirements, including acceptance tests, are not met through these fault conditions.

Table 8 VAV AHU Fault Conditions

FC#1	Equation	DSPAVG < DSPSP - ƐDSP and VFDSPD ≥ 99% - ƐVFDSPD	Applies to OS #1 – #5
	Description	Duct static pressure is too low with fan at full speed	
	Possible Diagnosis	Problem with VFD Mechanical problem with fan Fan undersized SAT Setpoint too high (too much zone demand)	
FC#2 (omit if no MAT sensor)	Equation	MATAVG + ƐMAT < min[(RATAVG - ƐRAT), (OATAVG - ƐOAT)]	Applies to OS #1 – #5
	Description	MAT too low; should be between OAT and RAT	
	Possible Diagnosis	RAT sensor error MAT sensor error OAT sensor error	
FC#3 (omit if no MAT sensor)	Equation	MATAVG - ƐMAT > max[(RATAVG + ƐRAT), (OATAVG + ƐOAT)]	Applies to OS #1 – #5
	Description	MAT too high; should be between OAT and RAT	
	Possible Diagnosis	RAT sensor error MAT sensor error OAT sensor error	

FC#4	Equation	ΔOS > ΔOSMAX	Applies to OS #1 – #5
	Description	Too many changes in Operating State	
	Possible Diagnosis	Unstable control due to poorly tuned loop or mechanical problem	
FC#5 (omit if no MAT sensor)	Equation	SATAVG + ƐSAT ≤ MATAVG - ƐMAT + ΔTSF	Applies to OS #1
	Description	SAT too low; should be higher than MAT	
	Possible Diagnosis	SAT sensor error MAT sensor error Cooling coil valve leaking or stuck open Heating coil valve stuck closed or actuator failure Fouled or undersized heating coil HW temperature too low or HW unavailable Gas or electric heat unavailable DX cooling stuck on	
FC#6	Equation	| RATAVG - OATAVG | ≥ ΔTMIN and | %OA - %OAMIN | > ƐF	Applies to OS #1, #4
	Description	OA fraction is too low or too high; should equal %OAMIN	
	Possible Diagnosis	RAT sensor error MAT sensor error OAT sensor error Leaking or stuck economizer damper or actuator	
FC#7 (omit if no heating coil)	Equation	SATAVG < SATSP - ƐSAT and HC ≥ 99%	Applies to OS #1
	Description	SAT too low in full heating	
	Possible Diagnosis	SAT sensor error Cooling coil valve leaking or stuck open Heating coil valve stuck closed or actuator failure Fouled or undersized heating coil HW temperature too low or HW unavailable Gas or electric heat unavailable DX cooling stuck on Leaking or stuck economizer damper or actuator	

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 REQUIREMENTS OF REGULATORY AGENCIES

A. Provide design and installation in accordance with appropriate standards, codes and recommendations, applicable codes and ordinances including interpretations of such codes if known to the trade at the time of construction.

B. Reference Standards: All materials and equipment shall comply with applicable standards and requirements of the following:

1. California Electrical Code (CEC) 2019 Edition; (2017 NEC with 2019 California Amendments).
2. California Building Code - Title 24.
3. Uniform Fire Code (UFC).
4. Uniform Mechanical Code (UMC).
5. Uniform Building Code (UBC).
6. National Electrical Code (NEC).
7. National Fire Protection Association (NFPA).
8. National Electrical Manufacturers Association (NEMA).
9. National Electrical Contractors Association (NECA).
10. American National Standards Institute (ANSI).
11. Institute of Electrical and Electronic Engineers (IEEE).
12. Underwriters Laboratories (UL).

A. SUMMARY

1. Section Includes:

A. Electrical equipment coordination and installation.

B. Sleeves for raceways and cables.

C. Sleeve seals.

D. Grout.

E. Common electrical installation requirements.

B. SUBMITTALS

1. Submit in accordance with Division 1 sections.

C. COORDINATION

1. Coordinate arrangement, mounting, and support of electrical equipment:

   A. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

   B. To provide for ease of disconnecting the equipment with minimum interference to other installations.

   C. To allow right of way for piping and conduit installed at required slope.

   D. So, connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

2. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

3. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels (Furnished & Installed by Ceiling Subcontractor) are specified in Section 08 31 13 Access Doors and Frames.

4. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 07 84 00 Firestopping.

PART 2 - PRODUCTS

1. See individual Division 26 Electrical Sections.

PART 3 - EXECUTION

A. COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

1. Comply with NECA 1-2000 and facility standards.

2. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

3. 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.

4. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

5. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 SUMMARY

A. .General building wire.

B. Metal-clad cable (Type MC)

C. Flexible cord/cable (Type 'S').

D. Pull cord.

E. Wire splices, joints, and terminations.

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code (NEC)

B. Part 3, Title 24, California Electrical Code (CEC)

C. Underwriters Laboratories, Inc. (UL):

1. .UL-83, UL-44 - Thermoplastic-Insulated Wire and Cables.

2. .UL-4 - Armored Cable.

3. .UL-486A - Copper Connectors and Lugs.

1.3 SUBMITTALS

A. Submit in accordance with Division 1.

B. Provide manufacturer's literature describing products.

1. Wire, cable, and flexible cord.

2. Wire splicing and termination materials.

1.4 QUALITY ASSURANCE

A. Provide materials that are new or recycled.

B. Manufacturer: Company specializing in manufacturing products specified in this Section with 3 years’ experience.

1.5 PROJECT CONDITIONS

A. Verify that field measurements are as shown on the Drawings.

B. Conductor sizes are based on copper & aluminum.

C. Wire and cable routing shown on the Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

D. When wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.6 COORDINATION

A. Coordinate work under provisions of Division 1.

B. Determine required separation between cable and other work.

C. Determine cable routing to avoid interference with other work.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide wire, cable and connectors that bear the UL label or listing.

B. Provide wire and cable with 600-volt insulation rating unless otherwise noted.

C. Color coding for all conductors (including MC Cable).

1. Identify System conductors as to voltage and phase connections by means of color-impregnated insulation or colored marking tape; see Section 26 05 53 Identification for Electrical Systems.

2. 480Y/277-volt, 3 phase, 4 wire system:

   a. Phase A – Brown

   b. Phase B – Orange

   c. Phase C – Yellow

   d. Neutral – White or Gray

   e. Ground – Green

3. 208Y/120-volt, 3 phase, 4 wire system:

   a. Phase A – Black

   b. Phase B – Red

   c. Phase C – Blue

   d. Neutral – White

   e. Ground – Green

   f. IG Ground - Green with yellow tracer

4. Switch legs: Use same branch circuit phase color coding, which they are connected to, unless otherwise noted.

2.2 MANUFACTURERS

A. Wire and cable: Copper or Aluminum Conductors: Southwire, or equal

B. Connectors for wire and cable conductors: 3M, T&B, Ideal Industries, or equal.

2.3 BUILDING WIRE AND CABLE

A. Description: Single conductor insulated wire.

B. Conductor: Copper or Aluminum

C. Insulation Voltage Rating: 600-volts.

2.4 METAL-CLAD CABLE (TYPE MC)

A. Description: ANSI/NFPA 70, Type MC. Manufactured in accordance with NEC Article 334. AFC Type MC-Lite or equal.

B. Conductor: Copper or Aluminum

C. Insulation Voltage Rating: 600-volts.

D. Insulation Temperature Rating: 90 degrees C.

E. Insulation Material: Thermoplastic

F. Armor Material: Aluminum

G. Armor Design: Interlocked metal tape, corrugated tube, or smooth tube.

H. Ground: Internal insulated green copper conductor.

2.5 FLEXIBLE CORDS AND CABLE (TYPE 'S')

A. Provide Type 'S' flexible cords and cables manufactured in accordance with CEC Article 400.

B. Composed of two or more conductors and a full size green insulated ground wire with an outer jacket of rubber or neoprene.

C. Equip flexible cords and cables with wire mesh strain relief grips either as a integral component of the connector or as an independently supported unit.

D. Suspended flexible cords and cables using safety spring(s) unless otherwise noted on the Drawings.

2.6 PULL CORD

A. Empty branch circuit or system conduits: Provide mildew resistant polypropylene line, minimum 210-pound tensile strength. Greenlee Polyline, or equal.

B. Empty feeder conduits or ducts: Provide mildew resistant polypropylene rope, minimum 1/4-inch diameter. Durlaine, or equal.

2.7 WIRE SPLICES, JOINTS AND TERMINATIONS

A. Insulated Spring Connectors:

1. Wire connections for 8 AWG and smaller.

2. Electrical spring connector insulated with a color-coded, pliable, vinyl skirt. 3M/Scotchlok, or equal.

3. Self-striping pigtail and tap connectors are not permitted.

4. Insulation displacement connectors are not permitted.

B. Bolted Pressure Connectors:

1. Copper or Aluminum wire and cable connections. Provide split bolt for 6 AWG through 4/0 AWG and two-piece connector for 250 AWG and larger. Burndy Type KS/KVS, or equal.

C. Compression Type Terminating Lugs:

1. Copper or Aluminum wire and cable connections as required. Use long barrel type, tin plated copper compression lugs having color-keyed tool die index marking. Provide 1-hole lugs for 8 AWG through 4/0 AWG. Provide 2-hole lugs for 250 AWG and larger. Use minimum of three crimps per lug or as recommended by the manufacturer. T & B Series 54800/54900, or equal.

2. Notch or single point type crimping is not permitted.

D. Splicing and Insulating Tape (600 Volts and Below):

1. Provide black, ultraviolet proof, self-extinguishing, 7 mils thick vinyl general purpose electrical tape. Suitable for temperatures from minus 18 degrees C to 105 degrees C. Scotch 33+, or equal.

E. Insulating Compound (600 Volts and Below):

1. Vinyl Mastic: Self-fusing, rubber-based insulating compound, laminated to an all-weather grade vinyl (PVC) backing. 3M/Scotch 2200 Series or equal.

2. Insulation Putty: Electrical grade, rubber-based, elastic-type putty in tape form. 3M Scotchfil, or equal.

F. Insulating Resin:

1. Use two-part liquid epoxy resin with resin and catalyst in premeasured, sealed mixing pouch. Scotchcast 4, or equal.

2. Use with thermal and dielectric properties equal to the insulating properties of the cables immersed in the resin.

G. Terminal Strips:

1. Provide box type rail mounted terminal block system. Furnish required quantity plus 25 percent spare. Install using continuous rows method in terminal cabinets. Provide ampere ratings as required. T & S Series HR, GR, or equal.

2. Identify all terminals with same numbering sequence being used for a particular system. Use marking strips to identify terminals.

H. Crimp Type Connectors:

1. Provide insulated fork or ring crimp terminals with tinned electrolytic copper-brazed barrel, funnel wire entry and insulation support. T & B RA Series, or equal.

2. Fasten crimp type connectors or terminals using a crimping tool recommended by the connector manufacturer.

3. Provide insulated overlap splices with tinned seamless electrolytic copper barrel with funnel wire entry and insulation support. T & B Series R or equal.

4. Provide insulated butt splices with tinned seamless electrolytic copper barrel with center stop, funnel wire entry and insulation support. T & B Series R, or equal.

I. Cable Ties:

1. Provide harnessing and point-to-point wire bundling using nylon cable ties, T & B Series TY or equal. Install ties using tool supplied or recommended by the manufacturer of ties.

J. Wire Lubricating Compound:

1. UL listed for the wire insulation and conduit type. Ideal, CRC or equal.

2. Use on wire for isolated type electrical power systems is not permitted.

K. Bolt Termination Hardware:

1. Bolts: Plated, medium carbon steel heat treated, quenched, and tempered conforming to ASTM A-325 or SAE grade 5; or silicon bronze alloy ASTM B-9954 Type B.

2. Nuts: Heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B steel or silicon bronze alloy.

3. Flat washers: Steel or silicon bronze, Type A plain standard wide series, confirming to ANSI B27.2. SAE or narrow series are not permitted.
4. Lock Washers: Hardened steel, cadmium plated or silicon bronze.
5. Maximum current capacity for bolt sizes:
    a. 1/4-inch bolt - 125 amps
    b. 5/16-inch bolt - 175 amps
    c. 3/8-inch bolt - 225 amps
    d. 1/2-inch bolt - 300 amps
    e. 5/8-inch bolt - 375 amps
    f. 3/4-inch bolt - 450 amps

L. Mechanical

1. Stud Kearney
2. Mechanical Lugs

PART 3 – EXECUTION

3.1 GENERAL WIRING METHODS

A. Install products in accordance with manufacturer's instructions.

B. Concealed dry interior locations; normal power systems: Use Type THHN insulation or MC Cable for branch circuit wiring. Use Type XHHW or dual rated THHN/THWN insulation for feeders.

C. MC Cable acceptable for concealed branch circuit wiring and final connections to fixtures.

D. Exposed dry interior locations: Use Type THHN insulation for branch circuit wiring. Use Type XHHW or dual rated THHN/THWN insulation for feeders.

E. Wet or damp locations: Use Type XHHW insulation for feeder and branch circuit wiring.

F. Use Type RHH or THHN insulation for wire installed in fixture channels.

G. Use stranded conductors only.

H. Use conductor not smaller than 12 AWG for power and lighting circuits.

I. Use conductor not smaller than 16 AWG for control circuits.

J. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

K. Parallel feeders: Install phase conductors and neutral conductors so that they are equal in length and identical in all ways.

L. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors; conductors larger than 10 AWG, bundle in individual circuits. Make terminations so there is no bare conductor visible at the terminal.

M. Minimum conductor size for 20 ampere power and lighting branch circuits having 4 or fewer current carrying conductors in a single conduit:

1. Use 10 AWG conductors for 120-volt branch circuits longer than 75 feet.

N. Minimum conductor size for 20 ampere power and lighting branch circuits having 12 or fewer current carrying conductors in a single conduit:

1. Use 10 AWG conductors for 120-volt branch circuits longer than 65 feet.

O. Provide 10 AWG pig tails on all 20A and 30A wiring devices served by 8 AWG conductors and larger.

P. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes. When more then one neutral is present, group and bundle each neutral with its associated phase conductors.

Q. Install cable supports for all vertical feeders in accordance with the CEC. Provide split wedge type fittings which firmly clamps each individual cable and tightens due to cable weight.

R. Panelboards, cabinets, wireways, switches, and equipment assembles. Neatly form, train, and tie the cables in individual circuits. Use nylon ties for securing cable/wire bundles.

S. Seal cable or wire, entering a building horizontally from underground or exiting walk-in cold box or freezer, using non-hardening approved compound, duct seal or equal. Seal at nearest box or panelboard raceway termination.

T. Use connectors with ampacity and temperature ratings equal to or greater than the wires that are being terminated.

U. Terminate stranded wire using fittings, lugs or devices listed for the application. Do not terminate stranded wire by wrapping it around a screw or bolt.

V. Flexible cords and cables supplied as part of a pre-manufactured fixture or unit assembly: Install according to manufacturer's published installation instructions.

3.2 WIRING INSTALLATION IN RACEWAYS

A. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

B. Pull all conductors into a raceway at the same time. Exercise care in pulling conductors so that insulation is not damaged.

C. Use UL listed, non-petroleum base and insulating type pulling compound as needed.

D. Completely mandrel all underground conduits prior to installing conductors.

E. Completely and thoroughly swab raceway system before installing conductors.

F. Do not use block and tackle, power driven winch or other mechanical means for pulling conductors smaller than 2 AWG.

G. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.

2. Use rope made of nonmetallic material for pulling feeders.

3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors.

4. Pull in together multiple conductors or cables in a single conduit.

5. Use wire-pulling compound as lubricant for installing wires and cables in raceways. Use of oil, grease, graphite, or similar substances is not permitted.

H. Install and test all cables in accordance with manufacturer's instructions and warranty.

3.3 CABLE INSTALLATION

A. Install MC Cable in accordance with manufacturer’s instructions and in accordance with NEC. Follow manufacturer's instructions when connecting the cable to fittings and boxes. Secure connectors to the cable, but not over tightened. Firmly attach connector to the metal boxes.

B. Support cables every 4.5 feet and within 12 inches of box or fitting using separate metal strap or spring metal clip for each cable. Do not bundle cables together.

C. Do not support cables from raceways or mechanical piping.

D. Do not rest cables on ceiling tiles or allow contact with mechanical piping systems.

E. Cable connection to light fixtures: Acceptable to attach cable to fixture support wire using spring metal clip.

F. Use steel with insulated throat cable connectors. OZ/Gedney AMC Series or equal.

G. Use cable having color coded conductors as noted. Color coded conductor sleeves are not permitted.

H. Provide separate sleeves or fire barriers for cable firewall penetration, unless cable is UL listed for the application.

3.4. WIRE SPLICES, JOINTS, AND TERMINATION

A. Join and terminate wire, conductors, and cables in accordance with UL 486A, B, & C, CEC, and manufacturers' instructions.

B. Thoroughly clean wires before installing lugs and connectors

C. Make splices, taps and terminations to carry full ampacity of conductors, without noticeable temperature rise.

D. Make splices and termination mechanically and electrically secure.

E. Where determined that unsatisfactory splices or terminations have been installed, remove the devices, and install approved devices.

F. Terminate wires in terminal cabinets, relay and contactor panels using terminal strip connectors.

G. Bundle spare conductors using nylon ties. Leave sufficient length to terminate anywhere in the panel or cabinet.

H. Use nylon cable ties for bundling and securing wire and cable as required to maintain harnessing.

I. Encapsulate below grade splices at outlet, pull and junction boxes using specified insulating resin kits. Make all splices watertight for exterior equipment and equipment in pump rooms.

J. Make up all splices and taps in accessible junction or outlet boxes with specified connectors. Use same color pigtails and wire tap as the feed conductor. Form conductor prior to cutting. Provide at least 6 inches of tail and neatly packed in box after splice is made up.

K. 8 AWG and smaller conductor connections:

1. Connectors: Solderless, screw-on, reusable spring pressure cable type, 600-volt, 105-degree C. with integral insulation, approved for copper conductors.

2. The integral insulator to completely cover the stripped wires.

3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.

L. 6 AWG and larger conductor connections:

1. Join or tap conductors using bolted pressure connectors or compression (hi- press) taps specified. Cover using moldable insulating compound and overwrapped with two half-lapped layers of vinyl insulating tape.

2. Terminate conductors from size 6 AWG to 750 MCM copper using bolted pressure or mechanical compression lugs in accordance with manufacturer's instructions.

3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less and that of the conductor level that is being joined.

4. Use hydraulic crimping tool for making compression indents. Burndy Series Y35 Hypress, or equal.

5. Apply oxide inhibiting compound to conductors before joining, installing compression lugs, or making terminations.

M. Termination Hardware Assemblies:

1. AL/CU lugs connected to copper bus. Secured using a steel bolt, flat washer (two per bolt), lock washer, and nut.

2. Copper lugs connected to copper bus. Secured using silicon bronze alloy bolt, flat washer (two per bolt), lock washer, and nut.

3. Install lock washers under the nut.

4. Torque bolted assemblies using the manufacturer's recommendations. In the absence of such recommendations, use torque values listed in UL 486 Standards.

5. Apply silicon spray or other suitable lubricant before torqueing bolts. Clean bolt surface after torqueing. Mark torqued bolt heads using red or pink lacquer paint. Torque Seal or equal.

3.5 IDENTIFICATION

A. Refer to Section 26 05 53 Identification for Electrical Systems for additional information.

B. Securely tag all branch circuits. Mark conductors with specified vinyl wrap-around markers. At each accessible location, mark each conductor with the corresponding circuit number.

C. Color code conductors' size 6 AWG and larger using specified phase color markers and identification tags.

D. Provide terminal strips with write on marking strips.

E. In manholes, Christy boxes and handholes, Provide embossed brass tags. Show the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

3.6 HOMERUNS

A. Permissible to combine up to 6 branch circuits (12 current carrying conductors) per conduit.

B. Individual homerun conduits containing more than 6 branch circuits are not permitted.

C. Adjust branch circuit conductor ampacity in accordance with CEC Article 310. Provide higher ampacity conductor sizes as needed.

3.7 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.8 FIRESTOPPING

A. Refer to Section 07 84 00 Firestopping for additional information.

B. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 00 Firestopping.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test conductors' size 4/0 and larger for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600V unless otherwise required by applicable Code or the University.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. 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.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-Clad; 3/4-inch by10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.

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. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors or irreversible crimp type, 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 or irreversible crimp type.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by CEC:

1. Feeders and branch circuits.

2. Lighting circuits.

3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.

7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

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. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.

2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

G. Metal 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.

3.3 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. For grounding electrode system, install at least 3 rods spaced at least one-rod length 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 26 05 33 Raceway and Boxes for Electrical Systems and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: 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 so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations, but 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, 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.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

1.2 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.

3. Equipment supports.

1.3 QUALITY ASSURANCE

A. Comply with CEC.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturer: Cooper B-Line, Inc.; a division of Cooper Industries or equal.

B. Raceway and Cable Supports: As described in NECA 1-2000 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported. Multi-function clips shall be allowable.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored 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 malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturer: Powers by DeWalt or equal.

2. 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 in which used.

    a. Manufacturers: Cooper B-Line, Inc.; a division of Cooper Industries, Powers by DeWalt or equal.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 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 05 50 00 Metal Fabrications for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1-2000 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1-2000 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 Light Steel: Sheet metal screws.

6. 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 meet seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 50 00 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.

3.4 CONCRETE BASES by DIV 03 Contractor

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 03 30 00 Cast-in-Place Concrete.

C. Anchor equipment to concrete base.

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.

3.5 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. Touchup: Comply with requirements in Section 09 91 00 Painting for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, cabinets, and underground duct banks for electrical wiring.

1.2 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) and marked for intended use.

B. Comply with CEC.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. IMC: ANSI C80.6.

C. EMT: ANSI C80.3.

D. FMC: Zinc-coated steel.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

2. Fittings for EMT: Steel compression or Set Screw type, insulated throat.

2.2 NONMETALLIC CONDUIT AND TUBING

A. ENT: NEMA TC 13.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. LFNC: UL 1660.

D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Manufacturers: Cooper B-Line, Inc., Hoffman, Square D; Schneider Electric, or equal.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include 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: Screw-cover type, or as indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Steel with snap-on covers Prime coating, ready for field painting.

1. Manufacturers: Thomas & Betts Corporation, Walker Systems, Inc.; Wiremold Company, or equal.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by University’s Representative.

1. Manufacturers: Hubbell Incorporated; Wiring Device-Kellems Division, Walker Systems, Inc.; Wiremold Company, or equal.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.

E. Nonmetallic Floor Boxes: Nonadjustable, round.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

H. Hinged-Cover Enclosures: 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. Nonmetallic Enclosures: Plastic.

I. 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.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.

2. Concealed Conduit, Aboveground: EMT or MC Cable.

3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC

5. Exposed Boxes and Enclosures, Aboveground: NEMA 250, Type 3R

B. Indoors: Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: Rigid steel conduit.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT or MC Cable

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

5. Damp or Wet Locations: Rigid steel conduit.

6. Raceways for Optical Fiber or Communications Cable: EMT, Flex, or Free Air Plenum.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.

C. Minimum Raceway Size: Power: 3/4-inch trade size. Communications: 1-inch trade size. All raceways: maximum 40 percent fill.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Threaded, or threadless compression-type fittings only.

2. Indoor EMT: Set screw or compression type, steel only. Die cast fittings will not be permitted.

3.2 INSTALLATION

A. Comply with NECA 1-2000 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Section 26 05 29 Hangers and Supports for Electrical Systems.

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equal to of four 90-degree bends in any conduit run .

G. 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.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

4. Rigid steel conduit in direct contact with earth, sand or encased in concrete must be double-wrapped with 3M 10- mil tape or equal.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors.

I. 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.

J. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit 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).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C temperature change.

d. Attics: 135 deg F (75 deg C) temperature change.

2. 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.

3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

K. Flexible Conduit Connections: Use maximum of 72-inches (1830 mm) of flexible

conduit for**,** equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations.

L. 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.

M. Set metal floor boxes level and flush with finished floor surface.

N. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

O. Color coding for junction boxes:

1. Fire alarm/life safety systems: Fluorescent red.

P. Legibly mark covers using black permanent ink felt pen; identify circuit(s) contained in the box by circuit number(s) and panel designation.

Q. Voice and data outlets shall have a minimum of one (1) 1-inch trade size conduit installed from the device box to readily accessible ceiling space with a standard 4-11/16-inch square by 2-1/8-inch deep device box with a single gang device ring installed flush mounted within the wall, unless otherwise noted.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

1. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

a. Couple steel conduits to ducts with adapters designed for this purpose.

b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

c. Rigid steel conduit in direct contact with earth, sand or encased in concrete must be double-wrapped with 3M 10-mil tape or equal.

d. Minimum radius of 48 inch for medium voltage conduits.

3.4 UNDERGROUND CONDUIT AND DUCT INSTALLATION

A. Duct lines shall be installed in accordance with the CEC, as shown on the drawings, and as specified.

B. Application:

1. Direct Burial Ducts: Schedule 40 or 80, minimum 24-inches below finished grade.

2. Below Building Slab-on-Grade: Schedule 40 or 80, minimum 4-inches below bottom of slab except that bends and penetrations through floor slab shall be PVC coated, or field-wrapped, galvanized rigid steel.

3. Below Roads and Paved Surfaces: Schedule 80, minimum 36-inches below finished grade.

4. Penetrations of building and equipment slabs: PVC insulated or field-wrapped rigid steel.

5. Concrete encased nonmetallic elbows are an acceptable substitute for rigid metal elbows.

C. Slope duct to drain towards manholes and handholes, and away from building and equipment entrances. Pitch not less than 4-inches per 100-feet.

D. Underground conduit stub-ups to inside of building and exterior equipment shall be PVC insulated rigid steel where it exits concrete.

E. Make joints in ducts and fittings watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

F. Terminate duct lines at manholes and handholes with end bells or precast terminators spaced 10-inches on center for 5-inch ducts and varied proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10-feet from the end bell without reducing duct line slope and without forming trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrance.

G. Separation between direct buried duct lines shall be 3-inches minimum for like systems and 12 inches minimum between power and signal ducts.

H. For concrete encased duct banks, install plastic spacers at maximum 5-ft. intervals and maintain 3-in. spacing between conduits. Install two reinforcing bars to anchor the conduits at 10-ft. intervals, to prevent floating during concrete pour.

I. Mandrel all ducts upon completion of installation and prior to pulling cables.

J. Medium voltage duct banks shall have minimum 3-inch cover on all sides, 2500 PSI Concrete with 10 lbs. red oxide per cubic yard. No color additive required on secondary duct banks.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to

restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Section 07 84 00 Firestopping.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 SUBMITTALS

A. Submit in accordance with Division 1.

1. Submit one sample of each of the following:
   a. Underground Line Warning Tape (6-inch sample).
   b. Warning Sign (one).
   c. Instruction Sign (one).
   d. Equipment Identification Label (one).

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with CEC.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.010-inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

2. Printing on tape shall be permanent and shall not be damaged by burial operations.

3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE, Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type I:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

2. Thickness: 4 mils (0.1 mm).

3. Weight: 18.5 lb./1000 sq. ft. (9.0 kg/100 sq. m).

4. 3-Inch (75-mm) Tensile According to ASTM D 882: 30 lbf (133.4 N), and 2500 psi (17.2 MPa).

D. Tag: Type ID:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, 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.

2. Overall Thickness: 5 mils (0.125 mm).

3. Foil Core Thickness: 0.35 mil (0.00889 mm).

4. Weight: 28 lb./1000 sq. ft. (13.7 kg/100 sq. m).

5. 3-inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 7 by 10 inches (180 by 250 mm).

C. Warning label and sign 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 for 120/208V Equipment: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES." (For 277/480V equipment, increase distance to 42 inches)

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equal process. Minimum letter height shall be 3/8-inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8-inch (10 mm).

C. Stenciled Legend: In nonfading, waterproof, black ink. Minimum letter height shall be 1-inch (25 mm).

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. 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

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands 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.

F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line 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.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 30-foot (10-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.

2. Power.

3. UPS.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

b. Colors for 480/277V Circuits:

1) Phase A – Brown.

2) Phase B – Orange.

3) Phase C – Yellow.

4) Neutral – White or Gray.

c. Colors for 208/120V Circuits:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

4) Neutral: White

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

F. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: or Baked enamel warning signs.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.

4. 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.

H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

I. 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.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. 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.

    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION

SECTION 26 05 73

SHORT CIRCUIT COORDINATION STUDY

PART 1 – GENERAL

1.1 SUMMARY

A. Provide a complete short circuit study, equipment interrupting or withstand evaluation, and a protective device coordination study for the electrical distribution system.

B. The study to include all portions of the electrical distribution system from the normal and alternate sources of power. Include all portions of the low voltage distribution systems as specified in this Section.

C. Study Basis: Thoroughly cover all normal or alternate operation modes that could produce maximum fault conditions.

1.2 REFERENCES

A. 2019 California Electrical Code - Part 3, Title 24, CCR.

B. NFPA 70 – National Electrical Code.

C. IEEE – Institute of Electronic and Electrical Engineers.

D. ANSI – American National Standard Institute.

1.3 SUBMITTALS

A. Comply with provisions of Division 1.

B. Submit study prior to final approval of the distribution equipment shop drawings.

1.4 QUALITY ASSURANCE

A. Study preparation by a registered electrical engineer, State of California.

B. Study based on the actual equipment and devices selected for the project.

C. Adhere to CEC requirements.

PART 2 – PRODUCTS – Not Used.

PART 3 - EXECUTION

3.1 SHORT-CIRCUIT STUDY

A. Perform study in accordance with applicable ANSI/IEEE Standards.

B. Study Input Data:

1. Utility company's short-circuit 1 and 2 phase contribution and the X/R ratio.
2. Resistance and reactance components of each feeder and branch impedance.
3. Motor and generator contributions.
4. All other applicable circuit parameters that contribute to the short-circuit duty.

C. Calculate the short-circuit momentary duties and interrupting duties on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.

3.2 EQUIPMENT EVALUATION STUDY

A. Perform an equipment evaluation study to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short-circuit ratings of these devices with the available fault currents.

B. Notify the IOR and General Contractor, in writing, about any problem areas or inadequacies in the equipment.

3.3 PROTECTIVE DEVICE COORDINATION STUDY

A. Perform a coordination study to select or check the selections of the following protective devices and components.

1. Power fuse ratings.
2. Protective relay characteristics and settings.
3. Ratios and characteristics of associated voltage and current transformers.
4. Low voltage breaker trip characteristics and settings.

B. Provide a coordination study that covers all voltage classes of equipment from the utility's incoming line protective device down to the following:

1. Medium voltage switchboards and distribution equipment.
2. Low voltage switchboards.
3. 480Y/277 and 208Y/120-volt distribution panels.
4. Motor Control Centers.
5. 480Y/277 and 208Y/120-volt panelboards.

C. Plot time-current characteristics of the specified protective devices using log-log paper. Include the following minimum information, as pertinent to system, on plots:

1. Complete titles.
2. Representation 1 line diagram and legends.
3. Power company's relays or fuse characteristics.
4. Significant motor starting characteristics.
5. Complete transformer parameters: include ANSI inrush and withstand curves.
6. Complete operating bands of low voltage circuit breaker trip curves.
7. Fuse curves.
8. Protective relay type selected and curves.
9. Cable damage curves.
10. Symmetrical and asymmetrical fault currents.

D. Maintain reasonable coordination intervals and separation of characteristic curves on plots.

E. Make coordination plots for phase and ground protective devices on a complete system basis.

F. Provide sufficient curves to clearly indicate the coordination achieved to utility main breaker, primary feeder breaker, unit substation primary protective device, main secondary breakers, substation feeder breakers, and load protective device rated 250 amperes or more.

G. A maximum of 8 protective devices are permitted for each plot.

H. Provide a separate tabulated list for the selection and settings of the protective devices. Include the following minimum information:

1. Circuit identification.
2. IEEE device number.
3. Current transformer ratios.
4. Manufacturer, device type and range of adjustment.
5. Recommended settings.

I. Provide a tabulation of recommended power fuse selections for the system.

J. Notify the IOR and General Contractor, in writing, about system discrepancies, problem areas or inadequacies.

3.4 STUDY REPORT

A. Summarized the results of the power system study in 1 bound final report.

B. Organize the report using the following sections:

1. Description, purpose, basis, written scope, and a single-line diagram of the portion of the power system which is included within the scope of study.
2. Tabulations of circuit breaker, fuse, and other equipment ratings versus calculated short-circuit duties, and commentary regarding same.
3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
4. Fault current tabulations including a definition of terms and a guide for interpretation.

3.5 IMPLEMENTATION

A. Coordinate with the provisions of Section 26 05 89 – ELECTRICAL STARTUP.

END OF SECTION

SECTION 26 05 89 - ELECTRICAL STARTUP

PART 1 - GENERAL

1.1 SUMMARY

A. This Section describes the requirements for start-up for Division 26 installed work, including but not limited to:

1. Power distribution system.
2. Emergency power system.

1.2 REFERENCES

A. National Electrical Testing Association (NETA).

B. American National Standard Institute (ANSI).

C. Institute of Electrical and Electronic Engineers (IEEE).

D. Per Section 260500.

E. Division 1 – GENERAL COMMISSIONING REQUIREMENTS.

1.3 SUBMITTALS

A. Comply with provisions of Division 1 - SUBMITTAL PROCEDURES.

B. Collaborate with the General Contractor to provide a complete start-up and training plan submittal for the electrical work.

1.4 QUALITY ASSURANCE

A. Provide testing equipment and accessories that are free of defects and are certified for use.

B. Provide testing equipment with current calibration labels.

C. Comply with start-up procedures to ANSI and IEEE guidelines. Incorporate manufacturer's recommended start-up procedures for equipment.

1.5 COORDINATION

A. Coordinate start-up work with the requirements of Division 1 - PROJECT MANAGEMENT & COORDINATION and GENERAL CONDITIONS.

B. Coordinate start-up requirements noted in other Division 26 Sections.

C. Coordinate commissioning requirements with the Owner's Commissioning Authority.

PART 2 - EXECUTION

3.1 EXAMINATION

A. Verify that equipment testing work is complete before starting functional performance of power equipment.

B. Verify that operational manuals are complete and been approved by the Architect before starting functional performance testing.

C. Inspect equipment and confirm that it is clean and ready for operation. All shipping tags removed, nameplates installed and equipment manuals in place.

3.2 PREPARATION

A. Provide at least one (1) journeyman electrician with tools and equipment necessary to perform functional testing.

B. Provide equipment factory representative for this work when needed.

C. Provide certified testing agency personnel for this work when needed.

3.3 POWER STARTUP

A. Perform start-up work after equipment is installed and system ready for operation.

B. Perform start-up work in accordance with Power Check Lists and equipment manufacturer's standard procedures and check lists, including but not limited to:

1 Verify test readings, such as:

a. Cable DC Hipot.

b. Circuit breaker tripping.

2. Verify that total power system is performing time delays outlined in the design intent under part and full load conditions.

C. Following installation of permanent panel directories, provide two electricians to perform the following verification process for all branch circuits and receptacles:

1. With one electrician stationed at panelboard and one electrician at receptacle or safety switch (in the case of equipment), connect tester and upon opening of corresponding circuit breaker, witness the circuit is de-energized. Provide as-builts as needed.

3.4 CHECKLIST - NORMAL POWER DISTRIBUTION

A. Prior to Functional Performance Test:

1. System in place, including all components indicated, and tested.

2. Connected to utility company power system on a permanent basis.
3. Wiring installed in conduits or other raceways.
4. System checked for unwanted grounds, short-circuits or open circuits.
5. Grounds installed as indicated, including transformers.
6. Equipment connections properly torqued.
7. Equipment, where indicated, on housekeeping pads.
8. Equipment cleaned and shipping blocks removed.
9. Proper ventilation of electrical rooms.
10. Electrical rooms free of foreign pipes and ducts.
11. Equipment labeled.
12. Boxes and nameplates meet color coding requirements.

B. Personnel to be present or assist as required to Perform Functional Performance Test:

1. General Contractor, Mechanical Contractor, Control Contractor, and Electrical Contractor, sub-contractor and specialty contractors as required.
2. Owner's Project Manager/Representative and/or Inspector of Record (I.O.R.).
3. Owner's maintenance staff, as desired.
4. Architect's Design Engineer(s).

C. Functional Performance Test: Demonstrate operation of normal power distribution system per specifications including the following:

1. Verify voltages and amperes at panelboards.
2. Verify voltages and amperes at mechanical motors and other major pieces of equipment.

D. Results:

1. If specified equipment performance is not verified, the General Contractor to have corrections made and reschedule Functional Performance Test as soon as possible after corrective work is completed.

3.5 CHECKLIST - EMERGENCY POWER DISTRIBUTION

A. Prior to Functional Performance Test:

1. System in place, including all components indicated, and tested.
2. Facility shall be connected to utility company power system on a permanent basis before emergency checklist is addressed.
3. Wiring installed in conduits or other raceways.
4. System checks for unwanted grounds, short circuits or open circuits.
5. Grounds installed as indicated, including transformers.

6. Ground fault settings made.
7. Equipment connections properly torqued.
8. Equipment, where indicated, on housekeeping pads.
9. Equipment cleaned and shipping blocks removed.
10. Proper ventilation of electrical rooms.
11. Electrical rooms free of foreign pipes and ducts.
12. Fuel oil in day tanks.
13. Intake and exhaust air, exhaust gas pipe and muffler, fuel oil piping installed.
14. Equipment labeled.
15. Boxes and nameplates meet color coding requirements.
16. Proper phase rotation coordinated between emergency and normal sources.

B. Personnel to be present or assist as required to performance Functional Performance Test:

1. General Contractor, Mechanical Contractor, Control Contractor, and Electrical Contractor, sub-contractors and specialty contractors as required.
2. Owner's Project Manager Representative and/or Inspector of Record (I.O.R.).
3. Owner's maintenance staff, as desired.
4. Architect's Design Engineer(s).

C. Results:

1. If specified equipment performance is not verified, the General Contractor to have corrections made and reschedule Functional Performance Test as soon as possible after corrective work is completed.

D. Reports

1. Submit reports of Functional Performance test (item C above) to Architect.

3.6 TRAINING

A. Coordinate with the training requirements of Division 1 - DEMONSTRATION AND TRAINING.

B. At job completion, allot a period of not less than 2 hours for instruction of building operating and maintenance personnel in the use of all systems. This instruction time (2 hours) is in addition to any instruction time called out in other Division 26 Sections.

C. Instruct all personnel at the same time. Contractor responsible for coordinating factory representative arrangements.

END OF SECTION 26 05 89

SECTION 26 09 13 - POWER MONITORING SYSTEMS AND CONTROL

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. Furnish and install a complete Power Monitoring and Control System (PMCS) as described in this specification. The system is defined to include, but not be limited to, remote devices for monitoring, control and protection, device communication interface hardware, inter-communication wiring, and ancillary equipment.

B. The manufacturer shall demonstrate that similar systems have been field installed and successfully operated for at least five years. The PMCS vendor shall have full responsibility for ensuring that the PMCS system performs as specified.

C. PMCS shall have a network system with gateway connection to BMS under Division 23.

1.2 RELATED WORK

A. Division 23.

B. Section 26 36 00: AUTOMATIC TRANSFER SWITCHES.

1.3 REFERENCES

A. All Power Meters shall be UL 508 Listed, CSA approved, and have CE marking. They shall also have certified revenue accuracy as per ANSI C12.20 and IEC 60687 class 0.5S or better.

B. The system shall comply with the applicable portions of NEMA standards. In addition, the control unit shall comply with FCC Emission Standards specified in Part 15, Sub-part J for Class A application.

1.4 SUBMITTALS

A. Indicate electrical characteristics and connection requirements. When PMCS components are installed by the power equipment manufacturer, the power equipment shop drawings shall clearly identify the components, the internal connections, and all contractor connections. The PMCS drawings shall show all PMCS components including necessary component dimensions; type, size, and weight; location of conduit entry and exit; single line diagram indicating external wiring requirements. Drawings shall identify terminal blocks used for interconnections and wire type to be used.

B. Product Data: Provide catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.

1.5 QUALITY

A. The PMCS vendor shall be ISO 9000 registered to demonstrate quality compliance.

B. PMCS components included within the power equipment lineups shall be factory installed, wired, and tested prior to shipment to the job site.

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. Square D Circuit Monitor Model PM8000 series.

B. Eaton IQ Analyzer Model IQA6600 series.

C. Approved equal.

2.2 POWER METERS

A. General Provisions:

1. All setup parameters required by the Power Meter shall be stored in nonvolatile memory and retained in the event of a control power interruption.
2. The Power Meter may be applied in three-phase, three- or four-wire systems.

B. Measured values:

1. The Power Meter shall provide the following, true RMS metered quantities:
   a. Real-Time Readings:
      1) Current (Per-Phase, N (calculated), 3-Phase Avg, % Unbalanced).
      2) Voltage (L–L Per-Phase, L-L 3-Phase Avg, L–N Per-Phase, 3-Phase Avg, % unbalanced).
      3) Real Power (Per-Phase, 3-Phase Total).
      4) Reactive Power (Per-Phase, 3-Phase Total).
      5) Apparent Power (Per-Phase, 3-Phase Total).
      6) Power Factor (Per-Phase, 3-Phase Total).
      7) Frequency.
      8) THD (Current and Voltage).
   b. Energy Readings:
      1) Accumulated Energy (Real kWh, Reactive kVarh, Apparent KVAh) (Signed/Absolute).
      2) Incremental Energy (Real kWh, Reactive kVarh, Apparent KVAh) (Signed/Absolute).

c. Demand Readings:

1) Demand Current Calculations (Per-Phase, 3-Phase Avg, Neutral):

(i) Present.

(ii) Running Average.

(iii) Last completed interval.

(iv) Peak.

2) Demand Real Power Calculations (3-Phase Total):

(i) Present.

(ii) Running Average.

(iii) Last completed interval.

(iv) Predicted.

(v) Peak.

(vi) Coincident with peak kVA Demand.

(vii) Coincident with kVAR Demand.

3) Demand Reactive Power Calculations (3-Phase Total):

(i) Present.

(ii) Running Average.

(iii) Last completed interval.

(iv) Predicted.

(v) Peak.

(vi) Coincident with peak kVA Demand.

(vii) Coincident kW Demand.

4) Demand Apparent Power Calculations (3-Phase Total):

(i) Present.

(ii) Running Average.

(iii) Last completed interval.

(iv) Predicted.

(v) Peak.

(vi) Coincident with peak kVA Demand.

(vii) Coincident kW Demand.

5) Average Power Factor Calculations, Demand Coincident (True), (3-Phase Total):

(i) Last completed interval.

(ii) Coincident with kW peak.

(iii) Coincident with kVAR peak.

(iv) Coincident with kVA peak.

d. Power Analysis Values:

1) THD – Voltage, Current (3-Phase, Per-Phase, Neutral).

2) THD - Voltage, Current (3-Phase, Per-Phase, Neutral).

3) Displacement Power Factor (Per-Phase, 3-Phase).

4) Fundamental Voltage, Magnitude and Angle (Per-Phase).

5) Fundamental Currents, Magnitude and Angle (Per-Phase).

6) Fundamental Real Power (Per-Phase, 3-Phase).

7) Fundamental Reactive Power (Per-Phase).

8) Harmonic Power (Per-Phase, 3-Phase).

9) Phase Rotation.

10) Unbalance (Current and Voltage).

11) Harmonic Magnitudes & Angles for Current and Voltages (Per Phase) up to the 31st.

C. Demand

1. All power demand calculations shall use one of the following calculation methods, selectable by the user:

a. Thermal demand using a sliding window updated every second for the present demand and at the end of the interval for the last interval. The window length shall be set by the user from 1-60 minutes in one-minute increments.

b. Block interval, with optional sub-intervals. The window length shall be set by the user from 1-60 minutes in 1-minute intervals. The user shall be able to set the sub-interval length from 1-60 minutes in 1-minute intervals.

D. Sampling

1. The current and voltage signals shall be digitally sampled at a rate high enough to provide true rms accuracy to the 63rd harmonic (fundamental of 60 Hz).

2. The Power Meter shall provide continuous sampling at a minimum of up to 128 samples/cycle, simultaneously on all voltage and current channels in the meter.

E. Minimum and Maximum Values:

1. The Power Meter shall provide monthly minimum and maximum values for the following parameters:

a. Voltage L-L.

b. Voltage L-N.

c. Current per phase.

d. Voltage L-L Unbalance.

e. Voltage L-N Unbalance.

f. True Power Factor.

g. Displacement Power Factor.

h. Real Power Total.

i. Reactive Power Total.

j. Apparent Power Total.

k. THD Voltage L-L.

l. THD Voltage L-N.

m. THD Current.

n. Frequency.

2. For each min/max value listed above, the Power Meter shall record the following attributes:

   a. Date/Time of the min/max value.

   b. Min/Max. Value.

   c. Phase of recorded Min/Max (for multi-phase quantities).

3. Minimum and maximum values shall be available via communications and display.

F. Harmonic Resolution

1. Advanced harmonic information shall be available via the Power Meter. This shall include the calculation of the harmonic magnitudes and angles for each phase voltage and current through the 31st harmonic.

2. Harmonic information shall be available for all three phases, current and voltage, plus the residual current. To ensure maximum accuracy for analysis, the current and voltage information for all phases shall be obtained simultaneously from the same cycle.

3. The harmonic magnitude shall be reported as a percentage of the fundamental or as a percentage of the rms values, as selected by the user.

G. Current Inputs

1. The Power Meter shall accept current inputs from standard instrument current transformers with 5-amp secondary output and shall have a metering range of 0-10 amps with the following withstand currents: 15 amp continuous, 50 amp 10 sec per hour, 500 amp 1 sec per hour.

2. Current transformer primaries through 327 kA shall be supported.

H. Voltage Inputs

1. The circuit monitor shall allow connection to circuit up to 600 volts AC without the use of potential transformers. The Power Meter shall also accept voltage inputs from standard instrument potential transformers with 120-volt secondary output. The Power Meter shall support PT primaries through 3.2 MV.
2. The nominal full-scale input of the circuit monitor shall be 347 Volts AC L-N, 600 Volts AC L-L. The meter shall accept a metering over-range of 50%. The input impedance shall be greater than 2 Ohm.

I. Accuracy

1. The Power Meter shall comply with ANSI C12.20 Class 0.5 and IEC 60687 Class 0.5 for revenue meters.
2. The Power Meter shall be accurate to 0.25% of reading + .025% of full scale for power and energy. Voltage and current shall be accurate to 0.075% of reading plus 0.025% of full scale. Power factor metering shall be accurate to ±.002 from 0.5 leading to 0.5 lagging. Frequency metering shall be accurate ±.01 Hz at 45-67 Hz.
3. These accuracies shall be maintained for both light and full loads.
4. No annual calibration shall be required to maintain this accuracy.

J. Alarming

1. Alarm events shall be user definable.
2. The user shall be able to define over 50 alarm conditions.
3. The following shall be available as alarm events:
   a. Over/under current.
   b. Over/under voltage.
   c. Current imbalance.
   d. Phase loss, current.
   e. Phase loss, voltage.
   f. Voltage imbalance.
   g. Over kW Demand.
   h. Phase reversal.
   i. Digital Input OFF/ON.
   j. End of incremental energy interval.
   k. End of demand interval.
4. For each over/under metered value alarm, the user shall be able to define a pick-up, drop-out, and delay.

5. There shall be four alarm severity levels in order make it easier for the user to respond to the most important events first.

6. Indication of an alarm condition shall be given on the front panel.

K. Feature Addition

1. It shall be possible to field upgrade the firmware in the Power Meter to enhance functionality. These firmware upgrades shall be done through the communication connection and shall allow upgrades of individual meters or groups. No disassembly or changing of integrated circuit chips shall be required and it will not be necessary to de-energize the circuit or the equipment to perform the upgrade.

L. Communications

1. The Power Meter shall communicate to the BACnet BMS via the Local Device Network. Coordinate protocol requirements with BMS Contractor.

M. Display

1. The Power Meter display terms in the English language.

2. The Power Meter display shall be back lit LCD for easy viewing, display shall also be anti-glare and scratch resistant.

3. The Display shall be capable of allowing the user to view four values on one screen at the same time. A summary screen shall also be available to allow the user to view a snapshot of the system.

4. The Power Meter display shall provide local access to the following metered quantities:

   a. Current, per phase rms, 3-phase average and neutral (if applicable).

   b. Voltage, phase-to-phase, phase-to-neutral, and 3-phase average (phase-to-phase and phase-to-neutral).

   c. Real power, per phase and 3-phase total.

   d. Reactive power, per phase and 3-phase total.

   e. Apparent power, per phase and 3-phase total.

   f. Power factor, 3-phase total and per phase.

   g. Frequency.

   h. Demand current, per phase and three phase average.

   i. Demand real power, three phase total.

   j. Demand apparent power, three phase total.

   k. Accumulated Energy, (MWh and MVARh).

   l. THD, current and voltage, per phase.

5. Reset of the following electrical parameters shall also be allowed from the Power Meter display:
   a. Peak demand current.
   b. Peak demand power (kW) and peak demand apparent power (kVA).
   c. Energy (MWh) and reactive energy (MVARh).
6. Setup for system requirements shall be allowed from the Power Meter display. Setup provisions shall include:
   a. CT rating.
   b. PT rating.
   c. System type.
   d. Watt-hours per pulse.

2.3 LOCAL DEVICE NETWORK

A. The local device network shall be interconnected with #18 gauge twisted pair shielded cable, 600 V Class Belden 9463 family, in properly sized conduit (when run outside of factory assembled equipment for the communication channel).

B. The local device network shall support up to five (5) data lines in a “star” configuration to minimize cable routing cost. The network shall support up to 200 devices on the five (5) data lines without repeaters providing the maximum cable distance between the ends of the longest lines is less than 10,000 feet.

C. The cabling shall be polarity insensitive. The communication speed at the device level shall be a minimum of 9600 baud. Devices shall communicate at their maximum baud rate regardless of the number of devices on the network.

D. All local device network communication system components shall have a dielectric isolation of a minimum of 2200 volts line-to-ground without damage to communication capability.

E. The local device network must permit the extension of the network via simple taps off of the main run without the need for doubling the cabling by inserting a new series connection into the main run.

F. Where Modbus interface to devices is required, (RS485PONI, MMINT, IQ7000, IQ230M & IQ330M), the contractor is to provide approved cabling and follow all Modbus wiring rules. Wiring to Modbus devices is to be limited to the appropriate number of devices per node, (i.e., 32), and is to include terminating resistors at the end of cable runs where required.

2.4 COMPONENT NETWORK INTERFACE

A. Furnish and install all required network interface modules for connection of the local device network to the BACnet BMS furnished under Division 23.

B. Coordinate with the BMS Contractor for physical media and protocol requirements. All work required for integration of the PMCS network and the BMS network is required under this Section of the Specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. PMCS components, including Power Meters, Electronic Trip Units, Transformer Temperature Monitors, Motor Protection Devices, and Digital Relays, included within the power equipment lineups shall be factory installed, wired, and tested prior to shipment to the job site.

B. All control power, CT, PT and data communications wire shall be factory wired and harnessed within the equipment enclosure.

C. Where external circuit connections are required, terminal blocks shall be provided, and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.

D. All wiring required to externally connect equipment lineups shall be installed by the electrical contractor.

E. Contractor interconnection wiring requirements shall be clearly identified on the PMCS system drawings.

3.2 SYSTEM START-UP AND TRAINING

A. On-site start-up and training of the PMCS shall be included in the project bid.

B. Start-up shall include a complete working demonstration of the PMCS with simulation of possible operating conditions that may be encountered.

C. Training shall include any documentation and hands-on exercises necessary to enable electrical operations personnel to assume full operating responsibility for the PMCS after completion of the training period.

END OF SECTION 26 09 13

SECTION 26 09 43

NETWORK LIGHTING CONTROLS

PART 1 – GENERAL

1.1 INTRODUCTION

A. The work covered in this section is subject to the requirements in the General Conditions of the Specifications. Contractor shall coordinate the work in this section with the trades covered in other sections of the specification to provide a complete and operable system.

1.2 SYSTEM DESCRIPTION

A. Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is the intent of this section to provide an integrated, energy saving lighting control system including Lighting Controllers, Photocells, Light Level Sensors, and Daylighting Controls from a single supplier. Contractor is responsible for confirming that all components operate as a single system.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Comply with CEC, NEMA, and FCC Emission requirements for Class A applications.

1.4 SUBMITTALS

A. Submit manufacturer's data on lighting control system and components including shop drawings, detailed point to point wiring diagrams, and floor plans showing occupancy and daylighting sensor locations. Provide typical mounting details for occupancy and daylighting sensors for this application.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. WattStopper Digital Lighting Management System

B. Approved equal:

1. Contractor shall be completely responsible for providing a system meeting this specification in its entirety.

2. All deviations from this specification must be listed and individually signed off by the consultant.

2.2 ADVANCED COMMUNICATIONS, INTEGRATION AND PC CONNECTIVITY

A. Provide an advanced communications network that supports PC connectivity, TCP/IP connections, advanced programming system documentation, enhanced diagnostics, historical and runtime accumulation, and graphic programming and control.

1. The system shall support the following advanced operating scenarios:
    a. Adjustable override periods for after hour use based upon the day of the week.
    b. Preemptive override before OFF to prevent blink warning and to start a new override time delay.
    c. Allow common areas to remain ON when specific relays in a panel are ON. Egress timer starts a countdown when the last watched relay turns OFF.
    d. Master Switch Control with blink option to provide a blink warning and five-minute countdown for occupants when a master switch is turned OFF.
    e. Interior daylighting control to turn OFF lights when available natural light meets occupants' lighting needs. Lights will only come on during occupied periods when enough natural light is not available.
    f. Occupancy Sensor Integration: Allows relays to automatically follow occupancy sensors' status or interlock the sensors with daily schedules.
2. Communications:
    a. Each panel shall support RS232 twisted pair and optional RS-485 connections. Either protocol may be used for programming, monitoring, and control. The data line shall allow simultaneous operation of multiple communications access points to support multiple operator terminals and communications with other building automation systems.
    b. Each panel shall be capable of stand-alone automatic operation and the network shall achieve full distributed processing.
    c. All programming shall be accomplished with a Windows based PC running compatible software package.
3. Hardware Features:
    a. Each communication control card shall be capable of providing all logic, control, runtime data, status information, and communications functions for up to 48 relays in a panel.
    b. EEPROM power loss memory and clock holdup time: 30 days.
    c. Self-diagnostics: Automatic diagnostics on all memory, input/output card modules, relays, and dataline.
    d. Clock: Digital with time, day of week, and date. Automatic leap year compensation. Programmable Daylight Savings Time and Standard Time adjustment.

4. Win Control Software:

a. Schedules:

1) Each communication control card shall support up to 24 unique weekly schedules out of a total of 1,000 available per system. Each schedule shall allow up to eight events per day for a repeating seven-day week.

2) Up to 32 holidays may be defined for any specific date. On that date any of the three holiday schedules may be assigned.

3) Relays may be programmed to switch to a different weekly schedule on any specific date, and then revert back to normal at another time. This allows for future schedule changes to be programmed ahead of time.

4) "Spring Ahead" and "Fall Back" dates for daylight savings time changes may be entered full two years ahead. Software also supports the ability to "Auto fill" in the next two occurrences of each of these dates.

b. Time Delay / Blink Warning:

1) Used during unoccupied periods, assignable for each relay.

(i) Time delays from 2 to 1,440 minutes.

(ii) Blink Warning: 1-second OFF blink followed by a 5-minute grace period before OFF.

(iii) An optional second blink warning one minute before OFF.

2) Operates automatically for all scheduled OFFs and time delay overrides.

3) Occupant overrides may be entered before the blink warning to prevent a scheduled blink and shutdown.

c. A total of 32 sets of trigger parameters may be established per panel.

d. Telephone Override:

1) Each relay shall respond to up to eight different telephone override codes. Maximum of 9999 telephone codes can be programmed.

e. Runtime Counters for Each Relay:

1) Cumulative runtime (up to 31 years) and number of cycles (up to 17 million) since last reset. User re-settable.

2) Daily runtime for the current day and each of the prior 40 days.

3) Monthly runtime for current and 14 prior months.

f. Activity Logs:

1) Store previous relay events including the time, new state, and cause for the change in state.

2) Annunciate over the dataline and RS232 port when the table is 25%, 50%, 75% and 100% full.

2.3 OPERATOR'S SOFTWARE

A. User programming and editing shall be conducted both online and offline in a Windows based software application.

B. Data shall be entered through a simple menu-driven user interface.

C. The software shall simplify integration with other software products by allowing the lighting control manufacturer's components to be embedded into other Windows applications. These features shall include the following:

1. BACnet connectivity with optional WebLink.
2. Drag and Drop interface programming supported throughout the program.

D. Basic operating software provides the following:

1. Site wiring documentation for all connected relay panels and system components.
2. English descriptions of each relay's circuit designation, circuit description, switch, and calculated load.
3. RS232 and TCP/IP Connection to Lighting Control Panel.
4. Monitor/Control all relays. Software shall show actual relay states, with an optional menu showing how and when the relay state occurred, and when next scheduled to change.
5. Simulate all functions.

E. System Parameters

1. System software to be sized based appropriately for the system – 250, 500, 750 or unlimited relays. Any number of sites may be programmed from a single software package (based on hard drive space).
2. Passwords Matrix Features allowed per site.
3. User defines functions accessible for each password (Document, Program, Initialize, Transfer from PC, Transfer to PC, Control, Simulate/Test).
4. Configure software to automatically contact remote sites using a modem or I/P address.

F. Other Features

1. Online help brings up a context sensitive help screen.
2. One step menu option to back up all site information to a backup drive.
3. The software shall include Trends and Relay Runtime Analysis that will allow the operator to analyze the operation of specific areas and identify those exceeding normal runtimes. Individual relays may be assigned a kWh weighted value or simply analyzed on a runtime basis. In both cases, the relays may be assigned to logical groups and plotted for the last 30 days or 12 months.

G. System Design Capability

1. From the lighting control system software database, the software shall be able to automatically create a system single line drawing, panel schedules and specifications that can be exported in DXF format for use in standard CAD drawings.

2.5 DIGITAL CONTROL DEVICES

A. Digital control devices shall be Wattstopper or equivalent:

1. Digital wall switch occupancy sensor: Wattstopper LMDW-102-W. Where device is shown with subscript “D,” program to dim.
2. Wall mounted dimmer control station: Wattstopper LMDM-101-W.
3. Wall mounted control station: Wattstopper LMSW-101-W.
4. Room controller relay: Wattstopper, as noted below:
   a. 1-switchleg, dimming: LMRC-211
   b. 2-switchleg, dimming: LMRC-212
   c. 3-switchleg, dimming: LMRC-213
   d. 1-switchleg, ON/OFF: LMRC-101
   e. 2-switchleg, ON/OFF: LMRC-102
5. Ceiling occupancy sensor: Wattstopper LMDC-100.
6. UL-924 emergency lighting short relay: Wattstopper ELCU-100

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Route wiring continuous between devices without splices.

C. Install all Class 1 line voltage wiring in conduit. Maintain complete separation between normal and emergency power wiring. Do not mix wiring of different voltage systems in the same conduits or boxes unless separated by metallic barrier.

D. Support Class 2 low voltage cable using bridle rings and J-hooks. Attach bridle rings to rod, using spring clips, above suspended ceilings.

E. Do not attach cable to ceiling wires, ceiling supports, conduits, ducts, or piping.

F. Use plenum rated cable for spaces used for environmental air.

G. Install Dataline riser cables in conduit.

H. Install cable in conduit above inaccessible ceiling spaces, in walls, and exposed wiring locations.

I. Install insulated throat fittings on conduit stub-outs for cable protection.

J. Install pull cord in empty conduits.

K. Provide nameplates and cable tags under provisions of Section 26 0553 – ELECTRICAL IDENTIFICATION.

3.2 WIRING

A. Terminate all wiring with manufacturer approved connectors.

B. All wiring shall be free from shorts and faults.

3.3 SYSTEM START UP AND COMMISSIONING

A. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all lighting control system components. The startup requirement is intended to verify:

1. That all occupancy and daylighting sensors are located, installed, and adjusted as intended by the factory and the contract documents.
2. The occupancy sensors and daylighting sensors are operating within the manufacturer's specifications.
3. The sensors and relay panels interact as a complete and operational system to meet the design intent.

B. Manufacturer to provide a written statement verifying that the system meets the above requirements.

3.4 SYSTEM TRAINING

A. Manufacturer shall provide factory authorized technician to train owner personnel in the operation, programming and maintenance of the lighting control system including all occupancy sensors and daylighting controls.

3.5 SYSTEM PROGRAMMING

A. Manufacturer shall provide system programming including:

1. Wiring documentation.
2. Switch operation.
3. Telephone overrides.

Operating schedules.

3.7 RECORD DRAWINGS

A. Provide as built drawings of all installed components and associated wiring on building plans and system wiring diagrams.

END OF SECTION

SECTION 26 22 13 – LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Two-winding transformers.

1.2 REFERENCES

A. NEMA ST 1 - Specialty Transformers (Except General-Purpose Type).

B. NEMA ST 20 - Dry-Type Transformers for General Applications.

C. Per Section 26 05 00.

1.3 SUBMITTALS

A. Comply with provisions Division 1 - SUBMITTAL PROCEDURES.

B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

C. Seismic Mounting: Provide transformer anchorage details.

1.4 QUALITY ASSURANCE

A. Furnish products listed and classified by Underwriters Laboratories, Inc. and suitable for purpose specified and indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - PRODUCT REQUIREMENTS: Transport, handle, store, and protect products.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

D. If exposed to weather of any kind, provide space heaters, and maintain winding temperature at minimum 70 deg. F for the duration of the exposure.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Square D.

B. Eaton.

C. PowerSmiths International Corp.

D. General Electric.

E.Or Equal

2.2 TWO-WINDING TRANSFORMERS

A. Description: NEMA ST 20, factory-assembled, air-cooled dry type transformers, ratings as indicated.

B. Primary Voltage: 480 volts, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase.

D. Insulation system and average winding temperature rise for rated kVA as follows:

1. 1-15 kVA: Class 185 with 80 degrees C rise.
2. 16-500 kVA: Class 220 with 150 degrees C rise.

E. Case temperature: Do not exceed 40 degrees C (maximum) and 30 degrees C (average) rise above ambient at warmest point at full load.

F. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

G. Sound Levels: NEMA ST 20.

H. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

I. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

J. Mounting:

1. 1-15 kVA: Suitable for wall mounting.
2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

K. Coil Conductors: Continuous copper or aluminum windings with terminations brazed or welded.

L. Enclosure: NEMA ST 20, Type 1 or 3R, ventilated, as indicated on the Drawings. Provide lifting eyes or brackets.

M. Isolate core and coil from enclosure using vibrating-absorbing mounts.

N. Energy Efficiency: All dry type transformers shall meet NEMA TP1 energy efficient (EE) requirements.

Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.3 SOURCE QUALITY CONTROL

A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit, under the provisions of Section 26 05 33, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.

D. Install floor-mounted transformers directly to floor slab per mounting details on drawings.

E. Mount trapeze-mounted transformers as indicated, otherwise floor mount.

F. Provide seismic restraints in accordance with California Building Code Title 24 and Uniform Building Code requirements.

G. Provide grounding and bonding in accordance with Section 26 05 26 - GROUNDING AND BONDING.

3.2 EQUIPMENT ENERGIZING

A. Clean and test equipment before energizing.

B. Maintain locked, clean and dust free premise for energized equipment.

3.3 TESTING & STARTUP

A. Refer to Section 26 05 89 -ELECTRICAL STARTUP requirements.

END OF SECTION 26 22 13

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Switchboards.

B. Switchboard accessories.

1.2 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers.

B. NEMA PB 2 - Dead Front Distribution Switchboards.

C. NEMA PB 2.1 - Instructions for Safe Handling, Installation, Operation and Maintenance of Dead Front Switchboards Rated 600 Volts or Less.

D. UL 891 - Switchboards.

E. Per Section 26 05 00.

1.3 SUBMITTALS

A. Comply with provisions of Division 1 - SUBMITTAL PROCEDURES.

B. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.

C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.

D. Seismic Design: Provide switchboard anchorage detail and manufacturer’s seismic certification.

1.4 SUBMITTAL FOR CLOSEOUT

A. OPERATION AND MAINTENANCE DATA: Submittals for project closeout.

B. Record actual locations of switchboard in project record documents.

C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALITY ASSURANCE

A. Seismic Qualifications: Provide switchboard that is designed and constructed in accordance with earthquake regulations of the Uniform Building Code and California Title 24.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - PRODUCT REQUIREMENTS: Transport, handle, store, and product products.

B. Deliver in 50-inch maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

E. Protect switchgear from moisture by using appropriate heaters as instructed by the manufacturer.

1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.8 MAINTENANCE MATERIALS

A. Division 1 - CLOSEOUT PROCEDURES.

B.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Square D.

B. Eaton.

C. Other approved manufacturer.

2.2 SWITCHBOARD

A. Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.

B. Provide ratings as shown on the Drawings.

C. Line and Load Termination: Accessible from the front, suitable for the conductor material used.

D. Main and Distribution Section Devices: Group mounted for 1200 ampere and smaller. Individually mounted for larger than 1200 ampere.

E. Bus Material: Copper.

F. Bus Connections: Bolted, accessible from front for maintenance.

G. Feeder Circuit Breakers Larger than 1600 Ampere: NEMA PB 2, factory-assembled insulated case circuit breaker, fixed mounted construction, manually operated. Equip with electronic trip sensing.

H. Feeder Circuit Breakers 1600 Ampere and smaller: Provide molded case circuit breakers, manually operated. Equip with electronic trip sensing.

I. Electronic Sensing: provide microprocessor based selectable trip unit, self-contained and field changeable. Equip with following trip-timing functions and features:

1. Protection: Long Time/Short Time/Instantaneous.
2. Information: Provide cause of trip indications or alarm switch.
3. Testing: Provide field testing provisions. Include test accessories, such as test kit.
4. Field interchangeable rating plugs.
5. Ground Fault Protection: As indicated or otherwise noted.

J. Interrupting Capacity: Minimum capacity as indicated on the Drawings.

K. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.

L. Provide ground fault protection where indicated. Provide ground fault protection on all switchboard main devices. Protection shall be integral to the electronic trip unit or an external relay system when thermal-magnetic circuit breakers are provided.

2.3 FABRICATION

A. Comply with the requirements of NEMA PB 2.

B. Comply with seismic qualifications in accordance with the California Building Code.

C. Construction: Indoor.

D. Ground Bus: Copper; extend length of switchboard. Ampacity not less than 25 percent of main bus rating.

E. Bussing Arrangement: A-B-C arrangement, left-to-right, top-to-bottom, front-to-rear, as viewed from the front.

F. Provide 100 percent rated capacity neutral bus.

G. Provide 100 percent rated capacity main bus throughout switchboard.

H. Provide accessory fuse blocks, control devices and wiring as required. Use 14 AWG (minimum) grey switchboard type wire. Terminate conductors using terminal blocks.

I. Provide Infrared Scanning Windows in exterior enclosure for all field terminations. Scanning windows shall be at least 4-inch diameter. FLIR IRW-4C or approved equal.

2.4 FACTORY FINISHES

A. Clean surfaces before applying paint.

B. Apply corrosion-resisting primer to all surfaces.

C. Apply finish coat of baked enamel paint to 4 mils thick.

D. Finish Color: Manufacturer’s standard light grey finish.

2.5 NAMEPLATES

A. Nameplates and Warning Signs: Refer to Section 26 05 53 - ELECTRICAL IDENTIFICATION, for instructions.

2.6 SOURCE QUALITY CONTROL

A. Shop inspects and test switchboard according to NEMA PB 2.

PART 3 - EXECUTION

3.1 PREPARATION

A. Division 1 - PROJECT MANAGEMENT & COORDINATION: Verification of existing conditions prior to beginning work.

B. Provide concrete housekeeping pad.

3.2 SEISMIC MOUNTING

A. Provide switchboard anchorage details, coordinated with the switchboard mounting provision, prepared, and stamped by a licensed structural engineer.

B. Install switchboard in accordance with earthquake regulations of the California Building Code.

3.3 INSTALLATION

A. Install switchboard in locations shown on Drawings, according to NEMA PB 2.1.

B. Tighten and torque accessible bus connections and mechanical fasteners, in accordance with manufacturer’s instructions, after placing switchboard.

3.5 SWITCHBOARD ENERGIZING

A. Clean and test switchboard before energizing.

B. Maintain locked, clean and dust free premise for energized switchboard.

3.6 STARTUP

A. Refer to Section 26 05 89 - ELECTRICAL STARTUP requirements.

END OF SECTION 26 24 13

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards 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."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each panelboard 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 bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in CBC Chapter 16.

D. Field quality-control reports.

E. Panelboard schedules for installation in panelboards.

F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled by a Nationally Recognized Testing Laboratory (NRTL), and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with CEC.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 1 year upon substantial completion date.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces in accordance with CBC Chapter 16.

B. Enclosures Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1, or equal.

b. Outdoor Locations: NEMA 250, Type 3R, or equal.

c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4, or equal.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

3. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Main and Neutral Lugs: Mechanical type.

3. Ground Lugs and Bus Configured Terminators Mechanical type.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Series rating is not allowed. AIC Rating to conform to Power system study results.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Square D, Eaton, or approved equal.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Mains: As indicated on Panel Schedules.

D. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive- locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Square D, Eaton, or approved equal.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Square D, Eaton, or approved equal.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. 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 with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

   a. Instantaneous trip.

   b. Long- and short-time pickup levels.

   c. Long- and short-time time adjustments.

   d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground- fault protection (6-mA trip).

6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.

   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads: Type HID for feeding fluorescent and high intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 Electrical Power Monitoring and Control.

f. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 26 28 13 Fuses.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.

1. Comply with mounting and anchoring requirements in accordance with the 2005 CBC Chapter 16.

B. Mount top of trim 90 inches (2286 mm) > above finished floor unless otherwise indicated.

C. Mount panel board cabinet plumb and rigid without distortion of box. Mount recessed panel boards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

H. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with 26 05 53 Identification for Electrical Systems.

B. Create a directory to indicate installed circuit loads and incorporating the University's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 Identification for Electrical Systems.

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 Identification for Electrical Systems.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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 stated in NETA Acceptance Testing Specification. 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.

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. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

SECTION 26 25 00 - ENCLOSED BUS ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Feeder-bus assemblies.
2. Plug-in bus assemblies.
3. Bus plug-in devices.

1.3 DEFINITIONS

A. kAIC: kiloampere interrupting capacity.

B. SPD: Surge protective device.

1.4 SUBMITTALS

A. Shop Drawings: For each type of product.

1. Show fabrication and installation details for enclosed bus assemblies. Include plans, elevations, and sections of components. Designate components and accessories, including clamps, brackets, hanger rods, connectors, straight lengths, and fittings.
2. Show fittings, materials, fabrication, and installation methods for listed firestop barriers.
3. Indicate required clearances, method of field assembly, and location and size of each field connection.
4. Detail connections to switchboards, transformers, and panelboards.
5. Cable and conductor terminal sizes for bus and plug-in device terminations.

B. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled bus-assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements. Show the following:

1. Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions.
2. Clearances for access above and to the side of enclosed bus assemblies.
3. Vertical elevation of enclosed bus assemblies above the floor or bottom of structure.
4. Support locations, type of support, and weight on each support.
5. Location of adjacent construction elements including luminaires, HVAC and plumbing equipment, fire sprinklers and piping, signal and control devices, and other equipment.

C. Seismic Qualification Certificates: For enclosed bus assemblies, plug-in devices, accessories, and components.

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. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed bus assemblies to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle enclosed bus assemblies according to NEMA BU 1.1, "General Instructions for Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less."

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Source Limitations: Obtain enclosed bus assemblies and plug-in devices from single source from single manufacturer.

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 UL 857.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed bus assemblies, plug-in devices, and components shall withstand the effects of earthquake motions determined according to California Building Code.

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."

2.3 ENCLOSED BUS ASSEMBLIES

A. Feeder-Bus Assemblies: Low-impedance bus assemblies in totally enclosed, nonventilated housing; single-bolt joints; ratings as indicated.

1. Acceptable Manufacturers: Square D, Eaton, or approved equal.
2. Electrical Characteristics:
    a. Voltage: 120/208V.
    b. Phase/Wire: 3-phase, 4-wire.
    c. Percent of Neutral Capacity: 100.
3. Temperature Rise: 55 deg C above 40 deg C ambient maximum for continuous rated current.
4. Bus Materials: Current-carrying copper or aluminum conductors, fully insulated with Class 130C insulation except at joints; plated surface at joints.
5. Voltage Drop:
    a. Measure voltage drop at 30 deg C ambient with bus thermally stabilized at full rated load.

b. Three-phase, line-to-line voltage drop less than 3.1 V per 100 feet at 40 percent power factor.

6. Ground: 50 percent capacity, internal bus bar of material matching bus material.
7. Enclosure: Steel, with manufacturer's standard finish.
8. Fittings and Accessories: Manufacturer's standard.
9. Firestop: Comply with UL 1479 firestop system, listed and labeled by an NRTL acceptable to authorities having jurisdiction for penetrations of fire-rated walls, ceilings, and floors.
10. Mounting: Arranged flat, edgewise, or vertically without derating. Rated for hanger spacing of up to 10 feet for horizontally mounted runs and up to 16 feet for vertically mounted runs.
11. Expansion Section: Manufacturer's standard expansion fitting for the provided busway with expansion capability to accommodate thermal expansion of bus and enclosure, and to accommodate movement across building expansion joints.

B. Plug-in Bus Assemblies: Low-impedance bus assemblies in totally enclosed, nonventilated housing; single-bolt joints; ratings as indicated.

1. Acceptable Manufacturer: Square D, Eaton, or approved equal.
2. Electrical Characteristics:

   a. Voltage: 120/208V.

   b. Phase/Wire: 3-phase, 4-wire.

   c. Percent of Neutral Capacity: 100.

3. Temperature Rise: 55 deg C above 40 deg C ambient maximum for continuous rated current.
4. Bus Materials: Current-carrying copper or aluminum conductors, fully insulated with Class 130C insulation except at stabs and joints; plated surface at stabs and joints.
5. Ground: 50 percent capacity, internal bus bar of material matching bus material.
6. Enclosure: Steel, with manufacturer's standard finish.
7. Plug-in Openings: 24 inches o.c. on each side of bus, and hinged covers over unused openings. Plug-in openings shall be finger-safe with covers open or closed.
8. Fittings and Accessories: Manufacturer's standard.
9. Firestop: Comply with UL 1479 firestop system, listed and labeled by an NRTL acceptable to authorities having jurisdiction for penetrations of fire-rated walls, ceilings, and floors.

10. Mounting: Arranged flat, edgewise, or vertically without derating. Rated for hanger spacing of up to 10 feet for horizontally mounted runs and up to 16 feet for vertically mounted runs.
11. Expansion Section: Manufacturer's standard expansion fitting for the provided busway with expansion capability to accommodate thermal expansion of bus and enclosure, and to accommodate movement across building expansion joints.

C. Joints:

1. Busway joints shall use one high-strength steel bolt with lock washers.
2. Bolts shall be torque indicating type and at ground potential.
3. Bolts shall be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated.
4. Access shall be required to only one side of the busway for tightening joint bolts.
5. Joint connection assemblies shall be removable without disturbing adjacent busway lengths.
6. Joint connection assemblies that rely on the joint cover to provide ground continuity are unacceptable.

2.4 PLUG-IN DEVICES

A. Fusible Switches: NEMA KS 1, heavy duty; with L-type fuse clips to accommodate specified fuses; handle lockable with two padlocks and interlocked with cover in closed position. Interlocked to prevent plug-in device insertion into or removal from bus with switch in closed position. See Section 26 28 13 "Fuses" for fuses and fuse installation requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate layout and installation of enclosed bus assemblies and suspension system with other construction that penetrates ceilings or floors or is supported by them, including luminaires, HVAC equipment, fire-suppression system, and partition assemblies.

B. Equipment Mounting:

1. Install enclosed bus assemblies on cast-in-place concrete equipment base(s).
2. Coordinate size and location of concrete curbs around openings for vertical bus. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Support bus assemblies independent of supports for other elements such as equipment enclosures at connections to panelboards and switchboards, pipes, conduits, ceilings, and ducts.

1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Section 260548.16 "Seismic Controls for Electrical Systems."
2. Design each fastener and support to carry 200 lb. or 4 times the weight of bus assembly, whichever is greater.
3. Support bus assembly to prevent twisting from eccentric loading.
4. Support bus assembly with not less than 3/8-inch steel rods. Install side bracing to prevent swaying or movement of bus assembly. Modify supports after completion to eliminate strains and stresses on bus bars and housings.
5. Fasten supports securely to building structure according to Section 26 05 29 "Hangers and Supports for Electrical Systems."
6. Bolts and nuts that are loosened for any reason after tightening to manufacturer's recommended torque setting shall be discarded and replaced with new bolts and nuts.

D. Install expansion fittings at locations where bus assemblies cross building expansion joints. Install at other locations so distance between expansion fittings does not exceed manufacturer's recommended distance between fittings.

E. Construct rated firestop assemblies where bus assemblies penetrate fire-rated elements such as walls, floors, and ceilings.

F. Coordinate bus-assembly terminations to equipment enclosures to ensure proper phasing, connection, and closure.

G. Tighten bus-assembly joints with torque wrench or similar tool recommended by bus-assembly manufacturer. Tighten joints again after bus assemblies have been energized for 30 days.

H. Install bus-assembly, plug-in units. Support connecting conduit independent of plug-in unit.

I. Comply with NECA 1.

3.2 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 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. After installing equipment test, for compliance with requirements according to NETA ATS.
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 correct connection according to single-line diagram.
    e. Inspect bolted electrical connections for high resistance using one or more of the following methods:
        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
        3) Perform thermographic survey.
3. Electrical Tests:
    a. Perform insulation resistance measurements through bolted connections and bus joints with low-resistance ohmmeter.
    b. Perform insulation resistance tests of each busway, phase to phase, and phase to ground.
    c. Perform a dielectric withstand voltage test on each busway, phase to ground with phases not under test grounded for one minute.
    d. Measure resistance of assembled busway sections on insulated busway and compare values with adjacent phases.
    e. Perform phasing test on each busway tie section energized by separate sources.
    f. Verify operation of busway space heaters.
4.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

E. Enclosed bus assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.4 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 25 00

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.

2. Snap switches and cover plates.

1.2 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour), or equal.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Pass & Seymour 5351W (single), 5362 (duplex), or equal.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed -through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125V, 20A:

1. Products: Pass & Seymour 2095W, or equal.

2.4 ISOLATED GROUND RECEPTACLES.

A. Receptacles, 125V, 20A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Pass & Seymour IG5261 – Orange (single), IG6300 Orange (duplex), or equal.

2.5 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277V, 20A:

1. Products: Pass & Seymour 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way), or equal.

C. Pilot Light Switches, 20A:

1. Products: Pass & Seymour PS20AC1-PLR for 120V, or equal.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277V, 20A:

1. Products: Pass & Seymour PS20AC1-L, or equal.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277V, 20A; for use with mechanically held lighting contactors.

1. Products: Pass & Seymour 1251, or equal.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches,120/277V, 20A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

G. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Products: Subject to compliance with requirements, provide the following:

a. Pass & Seymour 1251L or equal.

2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

2.6 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting Smooth, high-impact thermoplastic 0.035-inch- (1-mm-) thick, satin-finished stainless steel 0.04-inch- (1-mm-) thick, brushed brass with factory polymer finish 0.05-inch- (1.2-mm-) thick anodized aluminum 0.04-inch- (1-mm-) thick steel with chrome-plated finish.

3. Material for Unfinished Spaces: Galvanized steel smooth, high-impact thermoplastic.

4. Material for Damp Locations: Thermoplastic Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable cover.

2.7 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type or flap-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular Round, die-cast aluminum solid brass with satin finish as indicated on drawings.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening

2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Owner's Representative, unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Emergency Power System: Red.

3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to ensure that devices and their boxes are protected. 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 the 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 just 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 CEC, 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 all devices that have been in temporary use during construction or that show signs that they 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, 2/3 to 3/4 of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 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 down, and on horizontally mounted receptacles to the right.

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. 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, multi gang wall plates.

3.2 IDENTIFICATION

A. Comply with Section 26 05 53 Identification for Electrical Systems.

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. 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 not acceptable.

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.

C. The 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, and retest as specified above.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, enclosed controllers, and motor-control centers.

1.2 SUBMITTALS

A. Submit in accordance with Division 1.

B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) and marked for intended location and application.

B. Comply with NEMA FU 1 for cartridge fuses.

C. Comply with CEC.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following :

1. Cooper Bussmann, Inc. or equal.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

A. Feeders: Class L, time delay.

B. Motor Branch Circuits: Class RK5, time delay.

C. Other Branch Circuits: Class RK1, time delay.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 26 05 53 Identification for Electrical Systems and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Non fusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 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 and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.

D. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) and marked for intended location and application.

B. Comply with CEC.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Square D, Eaton, or approved equal.

B. Type HD, Heavy Duty, Single Throw, 240or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

4. Lugs: Suitable for number, size, and conductor material.

5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Product: Square D, Eaton, or approved equal.

B. Type HD, Heavy Duty, Single Throw, 240 or 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, Double Throw, 240 or 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. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Lugs: Suitable for number, size, and conductor material.

2.3 RECEPTACLE SWITCHES

A. Product: Subject to compliance with requirements, provide comparable product by the following: Square D, Eaton, or approved equal.

B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.4 SHUNT TRIP SWITCHES

A. Product: Subject to compliance with requirements, provide comparable product by the following: Cooper Bussmann, Inc., or equal.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough apacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight ON pilot light.

2. Isolated neutral lug.

3. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.

4. Form C alarm contacts that change state when switch is tripped.

5. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.

6. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Product: Subject to compliance with requirements, provide comparable product by the following: Square D, Eaton, or approved equal.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.

2. Long- and short-time pickup levels.

3. Long- and short-time time adjustments.

4. Ground-fault pickup level, time delay, and I^2t response.

E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

F. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 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.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, 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 stated in NETA Acceptance Testing Specification. 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.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

END OF SECTION

SECTION 26 32 13

ENGINE GENERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Description: Work specified in this Section includes the new automatic starting diesel engine-driven generator, complete with auxiliary equipment for use as an emergency and standby source of lighting and power.

B. The installation of the power generation system shall include the following:

1. Engine-driven generator set.
2. Cooling system.
3. Fuel supply and return including fuel cooling.
4. Skid-mounted fuel oil day tank.
5. Exhaust silencer.
6. Generator set accessories.
7. Seismic mounting system.
8. System control and switchgear integration.

1.2 QUALITY ASSURANCE

A. Qualifications of the Manufacturer and Assembler:

1. Standard Catalog Product: The engine-generator assembly shall be the standard cataloged product of an assembler, in the capacity range specified for both engine and generator, and for which parts and service are readily available from nearest service facility on 4 hour notice. Engine and generator shall be torsionally analyzed and torsionally matched per NEMA Standards.
2. Source: Both engine and generator shall be of U.S. manufacture. See subsequent Specifications for acceptable manufacturers.
3. Generator shall be assembled to engine by a franchised distributor for the engine manufacturer, and this franchised distributor shall be qualified to

extend the warranty of the engine and generator manufacturer for the assembled engine-generator, and shall perform a full load test of engine-generator assembly and submit test results to the Architect.

B. Codes and Regulations:

1. General: Per requirements in Section 26 05 00.

2. Generator: NEMA MG-1.

3. Circuit Breaker and Enclosure: NEMA SG-3.

C. Factory Tests and Inspections: Manufacturer's tests as specified hereafter.

D. Field Tests: As specified hereafter.

1.3 SUBMITTALS

A. Product Data: Submittals as called for in Division 1 shall include all products and accessories specified in this Section.

B. Shop Drawings: Submit layout drawing for engine generator and all accessories for approval.

C. Submit layout drawings for coolant, fuel, and exhaust system.

D. Electrical control, alarm, circuit breaker and synchronizing controls shall be accompanied with diagrams and function descriptions.

E. Permits: The Contractor shall obtain all necessary permits for installation and operation of generator set with state and local Air Quality Management District. Charges for installation and operation permits shall be paid by the Owner.

F. Seismic Design: The equipment is considered essential and shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) for zone 4 application. Provide generator set anchorage details and manufacturer’s seismic certification complying with CBC requirements.

1.4 WARRANTY

A. The manufacturer and dealer shall warranty the complete system for a period of not less than one (1) years from the date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. MTU Onsite Energy.

B. Generac.

C. Cummins / Onan.

D. Caterpillar.

E. Or Approved Equal.

2.2 SYSTEM DESCRIPTION

A. The electric power generating system shall have a site capability as shown on one-line diagram, at 0.8 power factor, 277/480 volts, wye connected, three-phase, 60 hertz.

B. The system shall consist of one generator set, which includes all controls, protection, wiring, and accessories for automatic start-stop operation.

C. The engine-generator and its equipment are part of an emergency power system, comprised of the generator set, transfer switches, and remote annunciation. The Contractor shall coordinate the system as a whole system. Provide interconnect shop drawings with wiring and terminals shown.

2.3 ENGINE GENERATOR, GENERAL

A. Capacity and Characteristics: The unit shall be standby duty, with a capacity in kW/kVA as shown on the one-line diagram at 0.8 power factor, 277/480 volts, wye connected, three-phase, 60 hertz.

B. The generator unit and accessories shall be in accordance with NFPA 99 and 110, and the generator shall pick up its load and stabilize to 5% of rated frequency within 10 seconds after loss of normal power source.

C. Rotational speed shall not exceed 1800 rpm.

D. Overall Size: Fit space available with adequate clearance over unit for inspection and servicing; at least 3’-0” clearance over the topmost points of the assembled unit within space available for convenience in servicing.

E. Interference-Free: Engine, generator and controls shall not generator any radio or television interference.

F. Operating Sequence: Engine-generator shall start either manually, or automatically on closure of a remote relay. Restoration of normal power source will be automatic, but engine shall continue to run until shut off by time delay relay.

G. Accessories shall include everything required for automatic starting and continuous operation. Selection shall be by the manufacturer of the unit, unless specified otherwise.

H. Structural steel frame shall extend under both engine and generator and radiator with spring type isolator units provided under entire assembly.

I.

J. Finish: Factory-applied lacquer or enamel.

K. Battery Wiring: Provide wiring between batteries and starter, and from battery charger to batteries.

L. Rotational Balancing: Engine shall be balanced at operating speed to a peak vibration not over 0.1" per second measured on 3 planes as close as possible to the flywheel, using instruments similar to that made by IRD Mechanalysis.

2.4 ENGINE

A. Type: General purpose, stationary, internal combustion, diesel, water-cooled, two stroke or four stroke cycle, compression ignition, airless injection, naturally aspirated or turbo-charged.

B. Lubrication System: Include oil pump, oil cooler which uses engine coolant, and a full flow oil filter, metal screen or cotton packed replaceable cartridge type wit filtration equal to 170 mesh screen. Furnish two replacement cartridges. Air-cooled cooler is not acceptable.

C. Engine Cooling: By a glycol-water solution; protected to zero degrees F; forced circulation through engine jacket and oil cooler; design working pressure of 25 psi minimum. Engine pumps shall be adequate to circulate cooling solution through the radiator.

D. Thermostatic Valve: Include in the engine coolant circuit, to limit circulation to the engine only, until coolant temperature equals or exceeds 160 degrees; with circulation through radiator, only above this temperature; mounted with the engine, and capable of full load cooling with coolant as specified, in 110 degrees F ambient.

E. Electric Heaters for Jacket Coolant: Universal, Kim or Perfection manufacturer; in the engine jacket cooling solution circuit; thermal siphon, shall add heat to the coolant, 208 volt, single phase; controlled by an insertion thermostat set at 90

degrees F, with 15 degrees F increase above ambient in the engine jacket, through a magnetic switch.

F. Engine Starter: Electric motor-driven, battery-powered, with solenoid operated contactor for starting motor.

G. Air Intake Filter: Replaceable media type; shall filter all air to the engine. Furnish two replacement cartridges.

H. Fuel Oil Filter and Water Separator: Replaceable cartridge type, size of cartridge to suit the required fuel oil flow; visible bowl for water; Racor Series 1000.

I. Fuel Cooler: Fuel shall be piped from the filter/water separators to the intake of the engine fuel pump, and then to the engine. Excess fuel shall be piped through the fuel cooler and returned to the day tank. The fuel cooler shall be capable of exchanging heat rejected at full load with the cooling medium, including 10% reserve to accommodate fouling.

J. Instrument Panel: Include pressure gauges for fuel oil and lubricating oil; coolant temperature gauge; thermometers for jacket water and for lubricating oil, a direct indicating mechanically-connected tachometer and an engine running time meter. All gauges and thermometers shall be equipped with electronic transducers, which repeat the indicated amounts in panel. Make all necessary connections between panel and engine.

K. Automatic Safety Shutdown: Safety alarm switches for high coolant temperature and low lubricating oil pressure, high lubricating oil temperature, overspeed and overcrank shall sound an audible and indicating light alarm on Derangement Signal System specified hereinafter, and in less than 60 seconds of an alarm condition, shall stop the engine by solenoid or motor-driven control of the governor trip lever or plunger; except that the engine will be shut down immediately at 10% overspeed or minimum oil pressure, by a mechanical governor mechanism. Low coolant temperature shall also actuate a Derangement Alarm, but shall not prevent engine from starting. Safety devices shall include all features required in NFPA 99 and 110.

2.5 GENERATOR AND CONTROLS

A. Manufacture and Type: Marathon, Lima Electric, Kato or Caterpillar-Century. Synchronous revolving field type, torsionally coordinated with the engine, drip-proof ventilated enclosure 277/480 volt, 3-phase, 4-wire, 60 hertz. Conform to ANSI C50.1 and to NEMA MG-1. The generator and flywheel shall have sufficient fly-wheel effect to meet the requirements of regulation and operation as specified. The rotor shall have amortisseur windings in the pole faces of the rotating field.

B. Windings: Stator and rotor shall incorporate magnet wire meeting NEMA MW

35C or 36C specifications, and shall be encapsulated with epoxy resins by vacuum pressure impregnation. All insulation materials shall have a minimum temperature rating of Class 155C per IEEE Std. 1.

C. Direct Mounting to Engine: Generator shall be single or two bearing type, torsionally coordinated with, and close coupled to the engine-driver.

D. Environment: The alternator shall be designed for resistance to salt and moisture laden air to inhibit rusting of internal and external metal parts and the breakdown of winding insulation.

E. Exciter: NEMA Standard, direct-connected brushless type or integral statically excited; non-contact type. The exciter shall operate in conjunction with the voltage regulator to supply the necessary generator excitation when the generator is connected for parallel operation, with power loads ranging from 0 to 125% of rated generator capacity. The exciter voltage regulator combination shall be capable of maintaining satisfactory generator output voltage at all loads from 0 to 125% of rated full load. Exciter shall be suitable for system as specified.

F. Voltage Regulator: Solid-state constant volts per hertz type to protect unit from an underspeed condition; shall automatically maintain terminal voltage within 1.0% of rated voltage, at all constant loads from no-load to full-load. Stable voltage conditions shall be re-established within 4 seconds following any sudden change of load. Vibrating contact type not acceptable.

G. Generator Control Panel

1. The generator set control panel shall control, protect, meter and annunciate all functions necessary to confirm the operational status of the generator set. It shall be designed and built by the engine generator manufacturer and incorporate 100% solid state microprocessor based control circuitry, with circuitry, keypad controls, and digital metering. Annunciation shall include individual alarm lights, which will allow fault identification while retaining a view of generator operating parameters, and a silencable audible alarm. Fault condition set points shall be verified without exposing the generator set to the actual condition.

2. Engine governing and overspeed fault circuitry shall utilize individual circuitry to assure speed control protection. Circuitry shall be sealed in a dust tight and watertight module with sealed wire entries into the enclosure. Internal terminal strips shall be both crimped and soldered to assure circuit integrity. Panel module shall comply with IP64 and NEMA 4 for environmental protection, while the total panel shall quality as NEMA 12.

3. Alternator AC output metering devices: Backlit LCD shall display frequency, three-phase voltage and amperage, with minimum numeral

height of 0.6 in. Accuracy shall exceed 0.5% true RMS.

4. Engine monitoring devices: Backlit LCD to sequentially rotate display of operating hours (reprogrammable), engine RPM, battery DC volts, oil pressure, and jacket water temperature. A momentary switch shall be provided to continuously display a selected operating parameter. The display shall provide specific codes for fault shutdown, cycle programming, and diagnostic codes for trouble shooting. Set points shall be programmable through a front mounted keypad, and sensor operation confirmed by a verification procedure. Engine monitoring signals provided by pulse wide modulated (PWM) lubricating oil pressure and coolant temperature sensors and communicated directly to the panel control module. The safety logic shall alarm or shut the engine down if the signal is lost.

5. Controls: Alternator voltage level rheostat and frequency control shall be mounted on the panel face. The engine start-stop switch shall be door mounted and include positions for off/reset, stop, and automatic mode. Start-stop logic shall have provisions for cycle cranking programmable from 5-60 second cycles, for total crank time of 5 to 120 seconds. Cooldown operation shall be programmable from 0 to 30 minutes with a signal to allow removal of the load from the generator set during cool down.

6. Safety Devices: ISO red emergency stop pushbutton shall be provided, and all controls, annunciation, and monitors labeled with ISO symbols.

7. Service: Complete viewing and programming of panel functions shall be possible from the panel face. Features shall include a fault history log, engine alarm and shutdown set points, password protection, spare input programming, hourmeter programming, voltmeter/ammeter programming, and AC calibration.

H. Generator Auxiliary Contacts: To indicate "run" status; control relay connected to circuits in generator shall close when generator is running, to actuate indicator circuits and for Automatic Transfer Switch Control. Refer to remote annunciator panel detail on the Drawings.

2.6 ENGINE-GENERATOR ACCESSORIES

A. Starting Controls Systems:

1. Scope: Provide all control equipment for automatic cranking and starting of the engine-generator unit.

2. Starting Control Relay: Include an adjustable cranking time limiter which shall cause three automatically cycled engine cranking intervals with a maximum of 30 seconds for each interval, followed by manual reset if engine fails to start; mounted in a cabinet. Include timing relays adjustable over 1-15 minutes, which will shut off the engine after it has run at no load for this length of time.

3. Mode Control Switch: On Generator Control Panel with "Manual," "Automatic" and "Test" positions.

B. Batteries and Battery Charging Equipment:

1. Scope: Provide a complete set of starting batteries and charging equipment for normal use.

2. Type of Batteries: Lead acid, 24 volt; capable of 8 hour recharge from full rated discharge without damage to battery plates.

3. Capacity of Batteries: Sufficient for not less than 90 seconds continuous cranking time with engine at a temperature of 50 degrees F. 380 ampere-hour minimum.

4. Condition: Batteries shall be new products at the time of startup of engine-generator. Do not add acid until startup, if batteries are dry charge type.

5. Battery Box: A battery tray shall be provided for the batteries and shall conform to CEC 480-7(b). It shall be treated to be resistant to deterioration by battery electrolyte. Construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the box to prevent a direct path to ground.

6. Battery Charger: LaMarche, Ratelco or Sens manufacturer, float voltage type with equalizing charge capability, line compensation, and an 8 hour recharge rate at full battery discharge; shall include silicon diode full wave rectifier, overload protection, voltage surge suppressors, D-C ammeter, fused A-C input, manually adjustable float voltage, 0-24 hour equalizing cycle timer with manual start; and charge failure visual alarm signal to indicate charging circuit malfunctions. Input shall be 120 volts.

7. Grounding: Polarity of battery connections to engine per engine manufacturer's recommendations.

8. Starting Motor Leads: Flexible stranded copper conductors and connectors (sized to carry the starting current draw for 60 seconds continuously without heating), insulated, with oil-resistive jacket; bolted bronze clamps at all battery terminals, protective coated to resist corrosion.

C. Engine Exhaust Silencer

1. Scope: Provide an Engine Exhaust Silencer with all required accessories and appurtenances for each generator. Silencer shall operate within the engine's maximum allowable exhaust backpressure limits. Silencer shall provide 25-35dbA attenuation.

2. Silencer shall be heavy duty steel construction with ANSI flanged connections.

3. Finish shall be high heat powder coat black paint. The system shall be insulated by installing contractor as required to maintain proper room temperature for generation.

D. Engine Coolant:

1. Description: Ethylene-glycol base, anti-freeze and water solution; 35% minimum by weight of ethylene-glycol; freezing protection to 0 degree F. Dow "Dowtherm" Type SR-1; glycol base.

2. Anti-Freeze Manufacture and Type: Dow "Dowgard;" industrial grade with rust inhibitors and anti-foaming agents, automotive grade anti-freezes not allowed. Submit name of supply source to the Architect for approval.

E. Derangement Signal and Annunciator System:

1. Description: A system of audible and visual derangement signals; powered by the diesel engine starting batteries; with two annunciators to indicate fault and operating conditions.

2. Signals: Per NFPA 99 and the following:

   a. Individual Visual Signals Shall Indicate:
      1) When the emergency or auxiliary power source is operating to supply power to load.
      2) When the battery charger is malfunctioning.
   b. Individual Visual Signals Plus a Common Audible Signal to Warn of an Engine-Generator Alarm Condition Shall Indicate:
      1) Low lubricating oil pressure.
      2) Low water temperature.
      3) Excessive water temperature.
      4) Low fuel when the main fuel storage tank contains less than a three-hour operating supply.
      5) Overcrank (failure to start).
      6) Overspeed.

3. Power Supply: Direct current from the engine starting batteries.

4. Audible Alarm Horn and Silencing Switch and Reset Switch: In the

annunciator.

5. Field Wiring: Provide in accordance with manufacturer's requirements.

6. Sensing elements shall be furnished for all conditions, except low fuel level contact in storage tank will be with level gauge specified in Division 15.

7. Annunciators: Provide one annunciator installation in local switchgear. Annunciator shall have a metal cabinet, and individual signals in the annunciator; shall require manual resetting after a fault condition has taken place. Annunciator shall use plug-in solid state elements and internal illumination.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Engine-Generator: Bolt unit to vibration isolators and provide anchor bolts for isolators to slab.

B. Provide anchorage details, coordinated with the substation mounting provision, prepared and stamped by a licensed structural engineer.

C. Install in accordance with earthquake regulations of the California Building Code.

3.2 FIELD TESTING

A. The emergency generator unit shall be field tested. The Contractor shall supply to the Architect all test data and results, and shall certify that such records are correct. All equipment and materials necessary for the test, including lubricating oil and fuel and all measuring and load equipment necessary for the tests, shall be provided by the Contractor. Tests shall prove that the performance of the unit is in conformance with the Specifications. Submit test forms and test procedures for approval at least one week before test date is established.

B. General Requirements:

1. Engine: Shall have complete electrical, lubricating oil, fuel, combustion air, starting and cooling systems.

2. Engine Instrumentation and Controls: The instrumentation and controls to the engine shall be complete.

3. Generator: The generator, complete with necessary exciter controls and regulator shall be tested.

4. Preliminary Test and Check-Off: Shall be made by a representative of the manufacturer, of fuel and lubricating oil levels, coolant levels and pump, safety controls, and all piping and electrical conditions.

C. Test Procedures:

1. Test Sequence: The sequence in which the tests are to be conducted shall be in the order specified hereinafter. Deviations from listed sequence is allowable at the discretion of the Architect.

2. Data Recording: Test data shall be recorded on forms furnished by the manufacturer. Data shall be legibly recorded and read to the units and decimal places specified on the sheet. When parameters listed on the data sheet do not apply, a diagonal line shall be drawn through the recording space provided. For each test operation, purpose and time of initiating the start shall be recorded, when it was stopped, with reason for stop. The unit instrumentation shall be used where applicable. Any replacement of parts shall be noted, stating reasons for replacement.

3. Operation conditions shall be observed by a representative of the manufacturer at all times of tests. All tests shall be conducted with the systems correctly connected. No protection or control systems shall be bypassed, unless it is specified.

4. Test Conditions Requiring Corrective Action: The unit shall be shut down if any of the following conditions occur and the tests shall be discontinued until the condition is corrected:

   a. Oil, fuel, air or water leaks.

   b. Abnormal engine noise or vibration.

   c. Persistent shutdown or warning by the unit's protection system.

   d. Relay arcing.

   e. Excessive engine or generator temperatures.

   f. Loss of oil pressure.

D. Fuel, Lubricants and Coolants:

1. Fuel: Engine shall be tested using No. 2 diesel oil.

2. Lubrication: The lubricating oil and other lubricants to be used shall be as designated and supplied by the manufacturer of the equipment.

3. Starting Power: Batteries provided with the unit shall be used for starting the engine.

4. Coolants: The ethylene glycol-water coolant provided with the unit shall be used.

E. Test Instruments:

1. General: The test instruments shall be calibrated and certified as being accurate. Instruments supplied with the unit shall be used when available; calibration of these instruments shall be certified by the manufacturer.

2. Recorder Instrumentation: A recorder shall be used to record transients of parameters listed below. The test number, name, and time of the test shall be entered on the trace immediately prior to obtaining the trace. Instrument transformers as required shall be provided. Transients of the following parameters are required during the load test and sudden load change test:

   a. General voltage, line-to-line, and line-to-ground, single phase (volts).
   b. Generator amperage, line current (amps), each phase.
   c. Generator frequency (Hz).
   d. Generator kilowatts, 3 phase, 2-1/2 or 3 element measuring (Kw).

3. Fuel Oil Meter: A meter and necessary piping connections shall be provided for measuring fuel oil consumption during the load test.

F. Generator system shall be tested per NFPA-110 7.13.

END OF SECTION

SECTION 26 36 00

TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Automatic transfer switch.

2. Non-automatic transfer switch.

B. Related Work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1. Section 26 09 13 - Power Monitoring & Control.

1.2 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. American National Standards Institute, Inc. (ANSI):

ANSI C37.90.1 - IEEE Guide for Surge Withstand Capability (SWC) Tests.

2. National Electrical Manufacturer Association (NEMA):

a. NEMA ICS 1 - General Standards for Industrial Control and Systems.
b. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.
c. NEMA ICS 4 - Terminal Blocks.
d. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

3. Underwriters Laboratories, Inc. (UL):

a. UL 467 - Grounding and Bonding Equipment.
b. UL 468A - Wire Connectors and Wiring Lugs for Use with Copper Conductors.
c. UL 1008 - Automatic Transfer Switches.

4. National Fire Protection Association (NFPA):

a. NFPA 110 - Emergency and Standby Power Systems.

1.3 SUBMITTALS

A. Submit in accordance with the requirements of Division 1 – SUBMITTALS PROCEDURES. Submit the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.

2. Describe system operation, equipment, dimensions and indicate features of each component.

3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

4. Shop drawings to include:

   a. Front, plan and side view elevations with overall dimensions shown.
   b. Location of devices and instruments and the make type, size and rating of all equipment.
   c. Dimensional locations of conduit entry points and locations of barrier plates.
   d. Nameplate legends.
   e. AIC rating.
   f. Size and number of bus bars per phase, neutral and ground.
   g. Detailed point-to-point wiring diagram, differentiating between manufacturer-installed and field-installed wiring.

5. Furnish structural calculations for equipment anchorage as described in Section 26 0500: Common Work Results for Electrical.

7. Certified independent laboratory test data shall be provided to confirm that the switch rating and design conforms to UL 1008.

8. Submit manufacturer's installation instructions.

9. Complete Bill of Material listing all components.

10. Warranty.

C. Dimensions and configurations of transfer switches shall conform to the space allocated on the drawings. The contractor shall submit a revised layout if equipment furnished varies in size from that shown on drawings for the engineer's approval.

1.4 OPERATION AND MAINTENANCE MANUAL

A. Furnish under provisions of Division 1 - CLOSEOUT PROCEDURES. Include the following:

1. A detailed explanation of the operation of the system.

2. Instructions for routine maintenance.

3. Detailed instructions for repair of the transfer switch.

4. Pictorial parts list and part numbers.

5. Pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, control panels, instrumentation, and annunciators.

6. Telephone numbers for the authorized parts and service distributors.

7. Include all service bulletins and torque specifications for all terminations.

8. Final testing reports.

1.5 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.

B. Only products and applications listed in this Section may be used on the project unless otherwise submitted.

C. Manufacturer qualifications: Firms regularly engaged in manufacture of transfer switches, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Transfer switch components shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no cost to Owner. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.

B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation.

C. Handling: Handle in accordance with NEMA PB2.1 and manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

1.7 WARRANTY

A. Units and components offered under this Section shall be covered by a 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon project substantial completion date.

1.8 SYSTEM START-UP

A. Upon completion of installation, initial start-up of the transfer switch shall be performed by a factory trained dealer service representative. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the witnessed test shall begin.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Automatic Switch Company (ASCO).

B. Russelectric Inc.

C. Square D Company.

D. Or Approved Equal

2.2 GENERAL REQUIREMENTS

A. Transfer switches shall be in accordance with specifications and as shown on the drawings.

B. Electrically operated by motor mechanism energized from the source to which the load is to be transferred. Mechanically and electrically interlocked in both directions.

C. Double-throw type switching arrangement, mechanically held in both directions.

D. Switch contacts shall be silver composition for switching load current. Units rated 225 amperes and more shall have separate arcing contacts.

E. Where 4-pole switches are indicated, provide 100 percent rated neutral switching capacity.

F. Train and bundle factory wiring and identify consistently with shop drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.

1. Designated terminals accommodate field wiring.

2. Power terminals arrangement and field wiring space.

3. Pressure-type terminals, suitable for copper or aluminum conductors,

sized as indicated.

4. Control wiring equipped with lugs suitable for connection to terminal strips.

G. Transfer switch ratings:

1. Voltage: 480/277 volts, 3-phase, 3- or 4- wire as shown on the drawings, 60 Hz.

2. Switched poles: 3- or 4-pole with switched neutral as shown on the drawings.

3. Switch operation: Open transition.

4. Continuous rating: as indicated on the drawings.

5. Interrupting capacity: 100 percent of continuous rating.

6. Withstand current rating: UL-1008; rated to withstand the available RMS symmetrical short circuit current. Rating shall match or exceed the value shown on drawings at distribution equipment serving transfer switch (on utility service side).

2.3 AUTOMATIC TRANSFER SWITCH (ATS)

A. The ATS shall be mechanically interlocked to allow the main contacts to be in only one of three positions:

1. Closed on the normal source.

2. Closed on the emergency source.

3. Center-off position.

B. The ATS shall be equipped with a safe manual operator, permanently attached to the motor operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

C. The ATS control section shall be supplied with a protective cover and be mounted at a location within the transfer switch enclosure suitable for ease of maintenance. Sensing and control logic shall be solid state type. Printed circuit boards shall be keyed to prevent incorrect installation. Interfacing relays shall be industrial control grade plug in type with dust covers.

D. The ATS shall be a lockable, non ventilated wall or floor mounted enclosure. The enclosure shall be NEMA 1 type, unless otherwise shown on the drawings.

E. All switch and relay contacts, coils, springs and control elements shall be removable from the front of the ATS without removal of the switch from the enclosure and without disconnection of drive linkages or power conductors.

F. All control relays shall be continuous duty, industrial type with wiping contacts rated at least 10 amperes.

G. The thermal capacity of the main contacts shall not be less than 20 times the continuous duty rating for a minimum of 3 electrical cycles as established by certified test data.

H. The ATS shall be provided with a front panel-mounted electronic power meter as specified in Section 26 09 13 - Power Monitoring System.

2.4 ATS CONTROL OPERATION

A. The control shall include, but not necessarily be limited to the following:

1. Voltage and frequency sensing monitors. Monitors shall initiate a standby sequence of operation upon complete loss or reduction of any phase to phase voltage to an adjustable range of 70% to 95% of rated voltage. The switch shall transfer to the standby source when its voltage reaches 95% of rated frequency and an adjustable value between 85% and 95% of rated voltage.

2. The switch shall retransfer to normal when the voltage reaches an adjustable value between 85% and 95% and all time delays have expired.

3. The standby sequence of operation shall be initiated upon loss or reduction of normal source voltage, after an adjustable time period of between 0 and 5 seconds. Retransfer to the normal source shall occur after the normal source has been restored for an adjustable time period of between 0 and 30 minutes. This time delay shall automatically be bypassed if the standby source should fail and the normal source is available. After retransfer to the normal source, the generator(s) shall continue to run for an adjustable time period between 0 and 5 minutes.

B. Accessories:

1. Form-C contact that operates when normal source fails for initiating engine starting, rated 10 amps, 32 VDC. Contacts shall be gold plated for low voltage service.

2. Green signal light to indicate when the ATS is connected to the normal source. A red signal light to indicate when the automatic transfer switch is connected to the emergency source.

3. Two white signal lights to indicate availability of both sources. The light shall illuminate only when the source is truly available, i.e. within normal

voltage and frequency tolerances; monitor three phases on the utility and one phase on the emergency.

4. All lights shall be visible without opening the cover. Provide single pushbutton to test all indicating lights.

5. Two auxiliary contacts that are closed when the automatic transfer switch is connected to normal and two auxiliary contacts that are closed when the ATS is connected to emergency. Rated 10 amps, 120 VAC. These contacts shall be used in remote annunciation of the ATS position therefore, provide a labeled terminal strip for field connected wires from this remote location.

6. A test pushbutton switch to momentarily simulate normal source failure. Pushbutton shall be spring maintained in the automatic position. Locate the pushbutton on the outside of the front cover. Provide for remote actuation of test signal from the engine generator paralleling switchgear.

7. Adjustable voltage sensing relays on each phase of normal source set to drop out and start the generator at 85% of normal and restore to utility at 90% of normal rating.

8. Voltage and frequency monitors to prevent transfer to emergency until the emergency source reaches 90% of its voltage and 95% of its frequency rating.

9. Time delay on restoring load to normal after power failure has ended, adjustable 0-30 minutes, set at 30 minutes. Any momentary dips in the line will cause the time delay to reset and start its time cycle over. This time delay shall be automatically by passed if the emergency source fails and the normal source is available.

10. Provide a pushbutton switch for manual transfer to normal to bypass the time delay. However, if the normal source fails, retransfer to emergency source should be automatic if the emergency source is available. Pushbutton shall be mounted to the front cover.

11. Time delay to delay generator-start signal and override momentary normal source outages, adjustable 0.5-6 seconds, set at 1 second.

12. Time delay on transfer to emergency source after emergency source becomes available, adjustable 0-5 minutes, set at 0 seconds for backup priority sequencing of loads. Primary priority sequencing of loads shall be performed by the engine generator paralleling switchgear.

13. Delayed transition switches shall have the following additional features:

    a. Time delay on transfer to emergency and re-transfer to normal of 0-300 seconds, during which the switch is held in the center-off position.

b. Two sets of Form-C auxiliary contacts to operate upon initiation of transfer and when transfer is complete.
c. Two sets of Form-C auxiliary contacts to operate upon transfer to the emergency source.

14. Provisions to permit load "shedding" by switching the main contacts to the center-off position via the closing of an external set of dry contacts, rated 120 VAC, 10 amperes.

15. A three position switch, TEST NO LOAD/TEST WITH LOAD/REMOTE, such that when in the TEST NO LOAD position and the test switch is activated the generators shall start but the transfer switch shall remain in the normal position. In the TEST WITH LOAD position the transfer switch will transfer to the emergency source. In the REMOTE position, transfer to emergency source is controlled by a remote signal from the engine generator paralleling switchgear. In any position, the transfer switch shall automatically transfer to the live source in the event of a failure of the other source. Mount switch to outside of front cover.

16. Provide an in-phase monitor which automatically measures the frequency difference between the two sources and initiates transfer at appropriate phase angles to minimize disturbances from transferring motor loads.

17. The above user adjustable devices, shall be adjustable without the use of tools, power supplies, meters, etc. The above settings shall be set at the factory.

18. Equipment grounding lug sized for ground wires shown on drawings.

19. Provide long barrel, 2 hole, high compression circumferential crimp type lugs for the feeder conductors, size as specified on the drawings. Bussing shall be designed to accommodate the number of crimp type lugs as required by the feeder size shown in the drawings.

20. All control wires shall be 600 volt, rated.

2.5 NON-AUTOMATIC TRANSFER SWITCH (NATS)

A. Electrically operated actuation by means of pushbuttons designated "normal source" and "alternate source." In addition, removable external manual handle, operable only with door closed, provides quick-make, quick-break manual switching action. NATS shall be capable of electrically or manually transferring the load in either direction with one or both sources energized. The control circuit disconnects from the electrical operator during manual operation.

B. Double-throw switching arrangement shall be incapable of pauses or intermediate position stops during switching sequence.

C. Accessories:

1. Pilot lights indicating source to which the load is connected. Green signal light to indicate when the ATS is connected to the normal source. A red signal light to indicate when the automatic transfer switch is connected to the emergency source.

2. Source available indicating lights which supervise sources via the NATS normal and alternate source sensing circuits, respectively. White lights with nameplates engraved "Normal Source Available" and "Alternate Source Available" respectively.

3. Provide one set of normally closed unassigned auxiliary contacts for each switch position, rated 10 amperes at 120 VAC.

2.6 ENCLOSURE

A. Transfer switch shall be wall mounted or free-standing, floor-mounted as shown on the drawings, NEMA ICS 6, type 1 smooth sheet metal enclosure constructed in accordance with UL 1008.

B Finish: Five step zinc phosphatizing pretreatment, one coat of rust inhibiting dichromate primer and one coat baked-on enamel finish, ANSI 49 (light gray).

2.7 SOURCE QUALITY CONTROL

A. Factory tests:

1. Transfer switch shall be completely assembled, wired, adjusted and tested, per ANSI C37.20, at the factory under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The minimum of the following tests shall be performed and the documentation and measurements shall be included in Operation and Maintenance Manual.

2. Dielectric test.

3. Mechanical test.

4. Grounding of instrument transformers test.

5. Electrical operation and control wiring test.

6. Control wiring.

7. Polarity test.

B. Submit the certified test reports to the Engineer to confirm that all components have been tested to substantiate designs according to applicable ANSI and NEMA Standards. Tests shall verify the performance of the components as well as the suitability of the enclosure venting, rigidity and bus bracing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Contractor shall thoroughly examine site conditions for acceptance of switchboard installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 PREPARATION

A. Ensure all conduit stub-ups for bottom entry into switchboard are in place and located as required per shop drawings.

3.3 INSTALLATION

A. Install transfer switch in accordance with manufacturer's written instructions, as shown on the drawings and as specified herein.

B. Seismic Mounting:

1. Transfer switches shall be accurately aligned, leveled and bolted in place on full length channels securely fastened.

2. Provide anchorage details, coordinated with the transfer switch mounting provision, prepared and stamped by a licensed structural engineer.

3. Install in accordance with earthquake regulations of the Uniform Building Code and California Title 24.

C. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in NETA Standard Tables.

D. Mark torqued bolt head using red or pink paint.

E. Replace any panel pieces, doors or trims having dents, bends, warps or poor fit which may impede ready access, security or integrity.

F. Conduits terminating in concentric, eccentric or oversized knockouts at transfer switch shall have ground bushings and bonding jumpers installed interconnecting all such conduits and the switch enclosure.

G. In damp and wet locations mount transfer switch with a minimum 1" of air space between enclosure and the wall or other supporting material.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's field service: Electrical contractor shall arrange and pay for the services of a factory-authorized service representative to supervise the initial start-up, pre-testing and adjustment of the switchboard.

B. At least three weeks prior to any testing, notify the electrical engineer so that arrangement can be made for witnessing test, if deemed necessary. All pre-testing shall have been tested satisfactorily prior to the engineer's witnessed test.

C. The electrical contractor shall supply a suitable and stable source of electrical power to each test site. The testing agency shall specify the specific power requirements.

D. Testing of overcurrent protective devices shall be done only after all devices are installed and system is energized.

E. Pre-testing:

1. Insulation resistance tests of buses, components, feeders and branch circuit conductors, and control circuits.

2. Continuity tests of circuits.

3. Provide testing agency with contract documents and manufacturer instructions for installation and testing.

4. Perform manual transfer.

F. Visual and mechanical inspection:

1. Inspect for physical damage, defects alignment and fit.

2. Perform mechanical operational tests in accordance with manufacturer's instructions.

3. Compare nameplate information and connections to contract documents.

4. Check tightness of all control and power connections.

5. Check that all covers, barriers, and doors are secure.

6. Perform manual transfer operation.

7. Confirm proper lubrication.

8. Check switch to ensure positive mechanical interlock between normal and alternate sources.

9. Ensure manual transfer warnings are attached and visible.

G. Electrical tests:

1. Perform insulation-resistance tests phase-to-phase and phase-to-ground with switch in both source positions. Test voltage shall be 1000-volts DC.

2. Perform a contact-resistance test across all main contacts.

3. Verify settings and operation of control devices in accordance with the specifications.

4. Calibrate and test all relays and timers including voltage and frequency-sensing relays, in-phase monitor (synchronism check), engine start and cooldown timers, transfer and retransfer timers, etc.

5. Perform automatic transfer tests:

   a. Simulate loss of normal power.
   b. Return to normal power.
   c. Simulate loss of emergency power.
   d. Simulate all forms of single-phase conditions.
   e. Monitor and verify correct operation and timing of the following simulations:
      i. Normal voltage-sensing relays.
      ii. Engine start sequence.
      iii. Time delay upon transfer.
      iv. Alternate voltage-sensing relays.
      v. Automatic transfer operation.
      vi. Interlocks and limit switch function.
      vii. Time delay and retransfer upon normal power restoration.
      viii. Engine cooldown and shutdown feature.

H. In the event that the system fails to function properly during the testing as a result of inadequate pre-testing or preparation. The contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the engineer's hourly rate.

I. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.

J. Contractor shall submit the testing agency's final report to the engineer for review prior to project close-out and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.5 CLEANING

A. Prior to energizing of transfer switch the contractor shall thoroughly clean the interior of enclosure clean the interior of enclosure of all construction debris, scrap wire, etc. using manufacturer's approved methods and materials.

B. Upon completion of project prior to final acceptance the contractor shall thoroughly clean both the interior and exterior of transfer switch per manufacturer's approved methods and materials. Remove paint splatters and other spots, dirt, and debris.

C. Touch-up paint any marks, blemishes, or other finish damage suffered during installation.

3.6 TRAINING

A. Factory authorized service representative shall conduct training for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance and testing of equipment with both classroom training and hands-on instruction.

B. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install lighting systems including:

1. Interior lighting fixtures, LED lamps, LED arrays, and drivers.
2. Exterior light fixture, LED lamps, LED arrays, drivers and poles.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections:

1. Section 26 27 26 Wiring Devices for manual wall-box dimmers and wall switch occupancy sensors.
2. Section 26 09 43 Network Lighting Controls for digital lighting controls.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LED: Light Emitting Diode

D. LER: Luminaire efficacy rating.

E. Lumen: Measured light output of lamp and luminaire, or both.

F. Luminaire: Complete lighting fixture, including driver housing if provided.

G. Pole: Luminaire support structure.

1.3 SUBMITTALS

A. Product Data: For each type of luminaire, pole and support structure, arranged in order of fixture designation in the fixture schedule. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. LED drivers. Including milliamp output and variable and adjustment parameters available.

3. Energy-efficiency data. Any exceptions to this requirement must be CLEARLY identified along with the reason for the exception.
4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps. Provide input watts for fixtures.
5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for LED light engines, drivers, and accessories identical to those indicated for the lighting fixture as applied in this Project.
   a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
   b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
6. Methods of field assembly and rough-in.
7. Poles: materials, dimensions, finishes, anchor bolts.

B. Shop Drawings: For nonstandard or custom lighting fixtures. 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. Wiring Diagrams: For power, signal, and control wiring.
   3. Anchor bolt templates, keyed to specific poles and certified by manufacturer.

C. Installation instructions.

D. 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. Lighting fixtures.
   2. Suspended ceiling components.
      3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches of the plane of the luminaires.
      4. Ceiling-mounted projectors.
      5. Structural members to which suspension systems for lighting fixtures will be attached.
      6. Other items in finished ceiling including the following, where applicable:
         a. Air outlets and inlets.

b. Speakers.
c. Sprinklers.
d. Fire Alarm Devices.
e. Occupancy sensors.
f. Access panels.
g. Telemetry antennas.
h. Wi-Fi antennas.

7. Perimeter moldings.

E. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

F. Field quality-control reports.

G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all the different drivers used in the complete fixture package for use by the operations staff.

H. Warranty: Provide complete warranty information for all lighting products.

1.4 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program 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, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in California Electrical Code (CEC), by a qualified testing agency, and marked for intended location and application.

D. Comply with CEC.

E. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.5 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.6 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency LED Driver Batteries: 1 year from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining years.

B. LED Fixtures: Provide minimum 1 year limited warranty on standard components or obtain written approval if less.

1.7 DELIVERY, STORAGE AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products by manufacturers and type only as specified in the documents for light fixtures and related lighting equipment.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit replacement of LED light engine without unnecessary disassembly. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during light engine replacement and when secured in operating position.

E. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
   b. UV stabilized.
2. Glass: As noted on fixture schedule.

F. Factory-Applied Labels: Comply with UL 1598. Include driver information. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when LED circuit boards are in place.

G. Exterior Luminaires shall be labelled for installation in wet locations.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 05 29 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 steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture. Must swing 45°.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Aircraft cable wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Aircraft cable wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.5 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics:

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed, with a gust factor of 1.3.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mounting, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete reinforcement and formwork are specified in Division 03 Section "Cast-in-Place Concrete".

2.6 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: As noted in fixture schedule.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded ½-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Wall mounted fixtures within the same field of vision shall be at the same height.
3. If wall construction is less than smooth, install wall mounted fixtures spaced off the wall with brackets so as not to accentuate the imperfect wall surface.

B. Permanent lighting used during construction: As the project gets closed up and parts of the building are complete and if approved by Architect, contractor may use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, inspect luminaires for any wear and repair to an “as new” condition. Provide new lamps and/or drivers if failure occurs.

C. Remote Mounting of Drivers: Distance between the driver and fixture shall not exceed that recommended by fixture manufacturer. Verify, with fixture manufacturers, maximum distance between driver and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently to the structure.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
5. The exact location of all fixtures shall be determined from dimensions derived in the Revit model and transferred to the Architectural reflected ceiling plan. Contractor shall compare the electrical lighting plan to the Architectural reflected ceiling plan and document any discrepancies. Install the light fixtures related to discrepancies as directed by response to discrepancy documentation.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches or otherwise required, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use aircraft cable support and power cable for wiring at one point and additional aircraft cable wires for suspension for each unit length of fixture chassis, including one at each end. Follow spacing recommendation of manufacturer and structural engineer.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

G. Pole/Bollard Installation:

1. Align pole foundations, poles and bollards for optimum directional alignment of luminaires and their mounting provisions on the pole.
2. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section “Cast-in-Place Concrete”.

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. 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.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes, but is not necessarily limited to:

1. Common standards and procedures for the Communications Work.

2. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Communications Systems. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.

B. Provisions of this Section apply to Communications Work, including the following Sections:

1. Section 27 05 26 – Grounding and Bonding for Communications Systems

2. Section 27 05 29 – Hangers and Supports for Communications Systems

3. Section 27 05 33 – Conduits and Backboxes for Communications Systems

4. Section 27 05 53 – Identification for Communications Systems

5. Section 27 10 00 – Structured Cabling, Basic Materials and Methods

6. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures

7. Section 27 11 19 – Communications Termination Blocks and Patch Panels

8. Section 27 11 23 – Communications Cable Management

9. Section 27 13 00 – Communications Indoor Backbone Cabling

10. Section 27 15 00 – Communications Horizontal Cabling

11. Section 27 41 16 – Integrated Audiovisual Systems and Equipment

1.2 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI/TIA/EIA-568-B.1-2001, Commercial Building Telecommunications Cabling Standard – Part1: General Requirements

2. ANSI/TIA/EIA-568-B.2-2001, Commercial Building Telecommunications Cabling Standard – Part2: Balanced Twisted Pair Cabling Components

3. ANSI/TIA/EIA-568-B.3-2000, Optical Fiber Cabling Components Standard

4. ANSI/TIA/EIA-606-A-2002, Administration Standard for Commercial Telecommunications Infrastructure

1.3 DEFINITIONS

A. General Abbreviations used in these specifications. Refer additionally to the abbreviations list appearing on the Drawings.

1.	ADA	Americans With Disabilities Act.
2.	AFC	Above Finished Ceiling.
3.	AFF	Above the Finished Floor.
4.	BLDG	Building
5.	CAT	Category
6.	CL	Centerline
7.	DIV	Division
8.	(E)	Existing
9.	FBO	Furnished By Owner
10.	HR	Home Run
11.	ID	Inside Diameter
12.	LAN	Local Area Network
13.	MAX	Maximum
14.	NIC	Not In Contract.
15.	OD	Outside Diameter
16.	OFE	Owner Furnished Equipment.
17.	PSRH	Project Standard Receptacle Height.
18.	PSSH	Project Standard Switch Height.
19.	TYP	Typical
20.	UON	Unless Otherwise Noted.

B. Reference to Named Products

1. Selected Item: Item so noted was selected based on comparative testing of similar products. Procedure for determination of equivalence is noted in the specification for the item(s).

2. System Design Basis: Item so noted interacts with other system items to produce total system function. Substitution of this item may require coordinated substitution of other system items.

3. Design Basis: Item so noted was used as basis for system drawings to establish features, size, etc. Use of specified equivalents may require adjustment of

physical layout or wiring, but does not affect system function. No preference is implied.

1.4 SUBMITTALS

A. Comply with the following:

1. Submit all materials for review arranged in same order as Specifications, individually referenced to Specification Section, Paragraph and Contract Drawing number. Conform in every detail as applies to each referencing Section.

2. Submit 8 ½ in.x 11 in. items bound in volumes and drawings in edge bound sets. Submit all drawings on sheets of the same size.

3. Make each specified submittal as a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.

B. Manufacturer's Product Data:

1. Manufacturer's Product Data Sheets. Collate in sequence of List of Materials:

2. Data sheet for each item in each Communications Section, including all accessories, clearly marked for proposed product.

3. Material Safety Data Sheet, where applies.

4. List of Materials Schedule. For each item, include:

a. Referencing Specification Section

b. Referencing Paragraph

c. Referencing Drawing, if specified only on plans

d. Manufacturer.

e. Model number.

f. Listing, including name of Nationally Recognized Testing Laboratory.

g. Precede each submittal book with a summary schedule, with columns for each item above and rows for each item submitted.

1) Example:

Specification Section	Paragraph	Contract Drawing Reference	Manufacturer	Model No.	UL/ CLA Listed
27 05 00	2.03C		XYZ	123	Y
27 15 00	2.07A1		AAA	34-56	Y
		T402	ZZY	456	Y

C. Field Installation and Shop Drawings:

1. General

a. Drawings shall use the makes and models of devices proposed for use this project; replace vendor neutral nomenclature used in bid set with.

b. Where the existing systems and/or infrastructure are used and integrated into the work of the project, indicate them on drawings, including points of interface and demarcation of existing and new work.

c. Collate, in sequence, at least the following minimum drawings, for each infrastructure and system to be installed under the work of this contract:

2. Drawing index/symbol sheet.

3. Site plans, floor plans and reflected ceiling plans.

a. General
   1) The identifier for each termination and cable shall appear on the drawings, either directly on the floor plans, through an associated schedule or an unique identifier associated with a fully annotated single line diagram.
   2) Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
   3) At scale of Contract Documents, show:
      a) Device locations and type
      b) Rough-in.
      c) Mounting height.
      d) Conduit size.
      e) J-hook routes
      f) Wire type.
      g) Wire fill.
   4) On the floor plans, indicate floor and wall mounted devices and pathway below a height of 7 feet above finish floor. Indicate the locations of the communications rooms and provide reference to the enlarged communications rooms plans.
   5) On the reflected ceiling plan, indicate ceiling and wall mounted devices and pathway above a height of 7 feet above finish floor. Indicate the locations of the communications rooms and provide reference to the enlarged communications rooms plans.

b. Communications Infrastructure
   1) Provide registered communications distribution designer (RCDD) approved, drawings depicting a complete communication infrastructure in accordance with ANSI/TIA/EIA-606-A. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the communications rooms including EF, ER, CD's, BD's, and FD's to the telecommunications work area outlets.
   2) The following drawings shall be provided as a minimum:
      a) T1- Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone

diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.

b) T-2 Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.

3) Indicate:
   a) Device locations, orientation and depict integration of systems that need to be viewed from the complete building perspective.
   b) For distributed speaker systems, indicate limits of zones of coverage.
   c) Vertical and horizontal pathways
   d) Equipment rooms and racks
   e) Reference to enlarged plans and related details.

4. Enlarged Plans

a. General
   1) Indicate at least as much information as is provided in the Contract Documents, supplemented by the dimensions and arrangement of the proposed equipment, trade coordination and field conditions.

b. Communications Infrastructure.
   1) Communications Rooms Drawings
      a) Provide T3 drawings in accordance with EIA TIA/EIA-606-A that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. Include rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.
      b) At scale of Contract Documents, the Contractor shall submit scaled drawing elevations (showing dimensions, mounting locations and associated frames & equipment) for all required assemblies, including but not limited to:
         (1) Rack locations
         (2) Telephone termination boards
         (3) Wall mounted backbone cabling and major station cable bundles.
         (4) Wall mounted splice cases
         (5) Wall mounted copper cable protectors and terminal blocks.
         (6) Wall mounted fiber optic cable terminations.
         (7) Clearances
         (8) Backboard Wire and Cable Management
         (9) Rack elevations, including
            i. Copper cable patch panels.

ii. Fiber optic cable patch panels.
iii. Rack mounted wire managers
iv. Hold clears for equipment provided by Others.
v. Reference to mounting details.
vi. Power strips
vii. UPS

2) Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

5. Detail Drawings

a. Mounting details:
1) Specific details of restraints including anchor bolts submitted under the Section 27 05 29 for mounting and maximum loading at each location, showing compliance and coordination with Code and the project Architectural, Structural and Mechanical Documents.
2) Stamped and signed by an Engineer licensed in the Project jurisdiction for work of this type.
a) Submit an accompanying Engineering analysis stamped and signed by an Engineer licensed in California for work of this type, indicating that the Equipment Enclosure System will comply with California Building Code for the Project Seismic Zone when loaded with the weight of the equipment submitted.
b) Show calculations on drawings or in bound volume for review by Authorities having jurisdiction.
3) Show loads, type and strength of connections, sizes, dimensions, materials, etc.
4) Provide details for:
a) Equipment Rack anchorage.
b) Wall Mounted Racks and Enclosures.
c) Cable Runway and Cable Tray
d) Ceiling and Wall Supported Projectors
e) Motorized and Manual Projection Screens
f) Wall and ceiling loudspeakers weighing 20 pounds or more.

b. Faceplate and Receptacles
1) Receptacle and jack arrangement for each condition.
2) Labeling of receptacle/jacks and plate
3) Plate material.
4) Plate finish.
5) Connector types.
6) Connector dimensioned layout.

c. Pathway
1) Cable tray installation details, indicating complete system of fittings and radiussed pathways provided.
2) Firestopping
3) Details of flexible raceway connections to be made to vibrating equipment

4) An itemized list of all items of equipment to be fitted with flexible electrical connections.
5) Conduit racking details.

d. California Access Compliance Manual and Americans with Disabilities Act (ADA) compliance.

e. For systems with contractor or manufacturer programmed control and human interfaces submit at least:
1) Narrative of the sequence of operation.
2) Color, full-size layouts of each touchpanel and/or computer screen (menu) image, cross-referenced to the sequence of operations.
3) Show chaining of sub-menus.

f. Terminal cabinets: Terminations.

g. Voice cable plant: Cut sheets for use by Owner's PBX Contractor

D. Samples: Samples for review by the Owner's Representative of all finishes/materials which will be visible to the public, including but not limited to:

1. Receptacles. The Contractor shall submit a mock up sample of each type of communication outlet including conduit, wall box, faceplate, communication cables, jacks and jack identifying labels.

2. The Contractor shall submit a sample of each type of label to be used for labeling cables, patch panels, termination frames, and faceplates for the telephone and data systems.

3. Surface Raceway, for each type:

a. Raceway base and cover, at least 5 foot section.

b. Boxes, at least two of each type to be used.

c. For other items, provide at least 2 in.x 2 in. sample.

E. Test Plan

1. Submit complete documentation of the proposed test plan and equipment to be used to document that the performance of the cabling, equipment, sub-systems and complete systems installed under the work of this project conform with the performance standards outlined in each specification section.

2. Submit not less than 45 days prior to the proposed test date. Include procedures for certification, validation, and testing.

F. Test Reports

1. Manufacturer's Field Reports

a. Factory reel tests

2. Project Site Test Reports:

a. Submit following system completion and prior to and as condition precedent to Acceptance Review and Testing of the Work of this Section.

b. Schedule: Submit test reports in timely manner relative to Project schedule such that the Owner's Representative may conduct verification of submitted test data without delay of scheduled progress.

c. Project Site test report:

d. Content: Include at least:
   1) Time and date of test.
   2) Personnel conducting test.
   3) Test equipment, including serial and date of calibration.
   4) Test object.
   5) Procedure used.
   6) Results of test
   7) Numerical or graphical presentation.
   8) Electronic file in format and media directed by the Owner's Representative.

1.5 QUALITY ASSURANCE

A. Designated Supervisor: Provide a designated supervisor present and in responsible charge in the fabrication shop and on the Project Site during all phases of installation and testing of the Work of this Section. This supervisor shall be the same individual through the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.

B. Reference Documents: At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies.

1. A complete set of the latest stamped, actioned submittals of record.

2. A complete set of manufacturer's original operation, instruction and service manuals for each equipment item.

C. Standard Products

1. Telecommunications Equipment. Provide telecommunications materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 1 year prior to bid opening. The 1-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 1-year period.

   a. Alternative Qualifications. Products having less than a 1-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 4000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

2. Material and Equipment Manufacturing Date

   a. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

D. Test Equipment

1. Requirements:

a. Maintain and operate test equipment at the fabrication shop and the job site for both routine and Acceptance Testing of the Work of this Section.

b. Maintain test equipment at the job site while work is in progress from installation of equipment racks until Owner Acceptance of this Work; thereafter remove all of this test equipment from the job site.

c. Unless otherwise indicated, test equipment shall remain property of the Contractor.

d. Provide all required test cables, jigs and adapters.

e. Provide equipment with traceable calibration, with calibration date not greater than one year prior to the date of the use of the equipment to perform the specified testing.

f. Calibration on test equipment must be verified by District Representative prior to beginning testing. Notify the District Representative 48 hours in advance of testing.

E. Qualifications

1. Communications Infrastructure work shall be performed by and the equipment shall be provided by the telecommunications contractor and key personnel. Qualifications shall be provided for:
   1) the telecommunications system contractor,
   2) the telecommunications system installer,
   3) and the supervisor (if different from the installer).

b. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

2. Key Personnel, General

a. Indicate the proposed key persons that are currently employed by the telecommunications contractor or who have a commitment to the low voltage systems and infrastructure contractor for the work of this project. All key persons shall be employed by the low voltage systems and infrastructure contractor at the date of issuance of this project, or if not, have a commitment to the low voltage systems and infrastructure contractor to work on this project by the date that the bid was due to the District's Representative.

b. Note that only the key personnel approved by the District's Representative in the successful proposal shall perform work on this project's low voltage systems and infrastructure systems. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the low voltage systems and infrastructure contractor's key personnel requires approval from the District's Representative.

3. Telecommunications Contractor

a. The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment.
   1) The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years.
   2) Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

b. Key Personnel
   1) Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this project depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.
   2) Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.
   3) In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this project. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this project. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity

4. Minimum Communications Infrastructure Manufacturer Qualifications

a. Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with ANSI/TIA/EIA-568-B.1, ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.3.

b. The contractor to be trained and certified to provide the following minimum manufacturer's warranty:
   1) Twenty (20) Year extended product warranty. A 20 Year extended product warranty shall ensure against product defects, that all approved cabling components exceed the specifications of TIA/EIA 568 and ISO/IEC IS 11801, and provide and end-to-end solution. The warranty shall apply to all passive cabling components. The 20 Year extended product warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s) for a twenty (20) year period.

c. Twenty (20) Year application assurance. A 20 Year application assurance shall cover the failure of the wiring system to support the application which it was designed to support.

1.6 REGULATORY REQUIREMENTS

A. Regulations Applicable:

1. Nothing in the Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, or regulations.

2. Safety Agency Listing: All devices provided under the Work of this Section which are connected to the Project electrical system shall be listed by a Nationally Recognized Testing Laboratory, and shall be so labeled.

3. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Owner's Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.7 DELIVERY, STORAGE AND HANDLING

A. General

1. Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.

1.9 SEQUENCING

A. Comply with the following.

1. Sequence.

a. Follow Foothill's Guidelines.

2. Reproduceables:

a. 1 set of reproducible bond.

b. CAD files: 1 set.

3. Contractor to use these number in preparing their shop drawings and in executing the work of the Project.

1.10 OPERATING AND MAINTENANCE DATA

A. Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system. Precede the manuals with a systems narrative specific to this Project, outlining the major systems functionality, the major systems components, and identifying which manuals document the performance of which subsystems.

1. Submit operations and maintenance data and as specified herein not later than 2 months prior to the date of beneficial occupancy or as specified in Division 1, whichever is sooner.

1.11 PROJECT RECORD DOCUMENTS

A. Comply with and the following. Include at least as much information as required for the submittal drawings.

1. Record Drawings

a. CAD.
1) Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. CAD system shall produce files in AutoCAD® .DWG format, version 2010 or later.

b. Except where prohibited by Contract, Owner's Representative will furnish CAD backgrounds in AutoCAD® .DWG format, for use by the Contractor in preparing Record Drawings.

c. Contractor shall be responsible for updating building and communications plans to reflect as-built conditions.
1) Indicate actual work on Drawings; indicate actual products used, replace vendor neutral nomenclature used in bid set with makes and models of actual installed devices.

d. Disk copy of Record Drawings: Provide 2 separate copies of each drawing file in the format noted above. Submit on CD-R disk.

e. Reproduceables: Provide 1 set of Bond paper.

2. Provide T5 drawings including documentation on cables and termination hardware in accordance with ANSI/TIA/EIA-606-A. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. Provide the following T5 drawing documentation as a minimum:

   a. Cables - A record of installed cable shall be provided in accordance with ANSI/EIA/TIA-606-A. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with ANSI/TIA/EIA-606-A. Include manufacture date of cable with submittal.

   b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with EIA TIA/EIA-606-A. Documentation shall include the required data fields as a minimum in accordance with EIA TIA/EIA-606-A.

1.12 WARRANTY SERVICE

A. Provide the following.

1. Response Time: Provide a qualified technician familiar with the work at the Project Site within 24 hours after receipt of a notice of malfunction. Provide the Owner's Representative with telephone number attended 8 hours a day, 5 days a week, to be called in the event of a malfunction.

B. Provide all additional Warranties as defined in each Communication Systems Section.

1.13 ACCEPTANCE REVIEW AND TESTING PROCEDURES

A. Complete all Work of this Section. Submit Test Report. Submit review copies of Operating and Maintenance Manuals, less reduced set of Record Drawings. Notify the Owner's Representative in writing that the Work of these Sections is complete and fully complies with the Contract Documents. Request Acceptance Review and Testing. The Owner's Representative will conduct Verification of Submitted Test Data, and otherwise direct testing and adjustment of this Work. These procedures may be performed at any hour of the day or night as required by the Owner's Representative to comply with the Project Schedule and avoid conflict with Residents. Provide all specified personnel and equipment at any time without claim for additional cost or time.

B. Personnel: Provide services of the designated supervisor and additional technicians familiar with work of this Section. Provide quantity of technicians as required to comply with Project Schedule.

C. In Addition, Provide:

1. All tools appropriate for performance of adjustment of and corrections to this Work. Include spare wire and connectors and specified tooling for application.

2. Ladders, scaffolding and/or lifts as required to access high devices.
3. All test equipment.
4. Complete set of latest stamped, actioned submittals of record for reference.
5. Complete set of Test Reports.
6. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.
7. Demonstrate: Complete operation of all systems and equipment, including Portable Equipment.
8. Adjust: As directed by the Owner's Representative.
9. Correct: In timely manner, failure to comply with the Contract Documents, as reasonably determined by the Owner's Representative.

D. Temporary Equipment: Provide and operate, without claim for additional cost or time, temporary equipment and/or systems to provide reasonably equivalent function, as determined by the Owner's Representative, in place of the Work of this Section which is incomplete or found not in conformance with the Contract Documents as of seven (7) days prior to the scheduled completion date. Provide such temporary equipment until Acceptance of the Work of this Section. Thereafter, remove such temporary equipment.

1.14 CLOSEOUT

A. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, retest and submit Test Report. Notify the Owner's Representative of completion of Punch List.

B. Portable Equipment: Furnish all portable equipment and spares to the Owner's Representative, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.

C. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit Manuals.

D. Project Record Documents: Submit print and digital copies as defined above.

E. Keys: If applicable, replace construction locks with permanent locks. Provide 5 sets of keys to the Owner's Representative.

F. Instruction: Conduct specified instruction.

G. Warranty: Submit Warranty dated to run from date of Acceptance of the Work of this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.

B. Each material, device or piece of equipment shall comply with all of the manufacturer's current published specifications for that item.

C. Products shall be made by manufacturers regularly engaged in the production of such products.

D. Provide quantity as shown on Contract Drawings, or as otherwise indicated.

E. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this Section as if specified in full herein.

F. Unless recycled content is specified, provide new materials.

G. Provide the manufacturer's latest design/model, permanently labeled with the manufacturer's name, model number and serial number.

H. Where products are of similar type or use, provide products of the same manufacturer, unless otherwise indicated.

I. Components

1. UL or third party certified. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance.

   a. The label or listing by the specified organization will be acceptable evidence of compliance.

   b. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Owner's Representative.

   c. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

J. Enclosures:

1. Provide steel frames and enclosures designed and wired to eliminate all induced currents.

2. Make bolted connections with self-locking devices.

K. Finishes: Any item or component of the Work of this Section which is visible shall comply with the following.

1. Finishes noted or scheduled on the Contract Drawings take precedence.

2. Where design location requires that products, materials or equipment are visible to the public, no manufacturer's logos larger than 1/2 inch shall be visible. Unless otherwise noted or directed, neatly remove or permanently paint out such logos.

3. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the Owner's Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing conditions before starting work. Submit conflicts in a timely manner for resolution

3.2 PREPARATION

A. Prepare and sequence the work to minimize disruption to each room environment and existing communications systems.

B. Protection: Cover all computers, electronic equipment, desks, chairs, furniture and other articles when working at ceiling level and/or performing dust producing tasks.

3.3 REPAIR AND RESTORATION

A. Where working in spaces occupied by the Owner, return to their original positions any furniture or articles relocated to perform the work.

3.4 CLEANING

A. Where working in spaces occupied by the Owner:

1. Immediately after completing work within each space, clean up and remove all materials, scrap and dust.

2. All scrap material in work area shall be picked up and removed from the building at the end of each day.

3. All dust resulting from work performed shall be vacuumed up daily.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Section includes grounding and bonding of Communications Work, including but not limited to:

1. Communications Raceways
2. Cable Runway
3. Cable Shields
4. Protector Fields
5. Communications cabinets and enclosures.

B. Related Work Under Other Sections

1. Related Sections:
   a. Section 27 05 00 – Common Work Results for Communications
   b. Section 27 05 29 – Hangers and Supports for Communications Systems
   c. Section 27 05 33 – Conduits and Backboxes for Communications Systems
   d. Section 27 05 36 – Cable Trays for Communications Systems
   e. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
   f. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
   g. Section 27 11 19 – Communications Termination Blocks and Patch Panels
   h. Section 27 11 23 – Communications Cable Management
   i. Section 27 13 00 – Communications Interior Backbone Cabling
   j. Section 27 15 00 – Communications Horizontal Cabling

1.2 SYSTEM DESCRIPTION

A. Provide telecommunications system grounding conductor as described herein and indicate on drawings.

B. Except as otherwise indicated, the complete communications installation including the metallic conduits and raceways, cable trays, boxes, cabinets and equipment shall be completely and effectively grounded in accordance with all code requirements, whether or not such connections are specifically shown or specified.

C. Resistance:

1. Resistance from the farthest ground bus through the ground electrode to earth shall not exceed 5 Ohms or the requirements of ANSI-J-STD-607-A-2002, whichever is more restrictive.

1.3 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI/TIA/EIA-606-B-2016 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

2. ANSI/TIA-607-D-2019 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

3. Underwriters Laboratories (UL)

4. UL 467 (1993); R 2004 Grounding and Bonding Equipment

1.4 SUBMITTALS

A. Conform with the requirements of Section 01 30 00 – Administrative Requirements and Section 27 05 00 Common Work Results for Communications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:

1. Ground Rod:

a. High strength high carbon steel, with electrolytically bonded jacket of copper on surface

b. UL spec. 467

c. ANSI C-33.8-1072.

d. Manufacturer:
1) Allied Bolt
2) Inwesco 12A60
3) Blackburn
4) Cooper Power Systems
5) Weaver.
6) Erico "Cadweld" Products, Inc.
7) ITT Blackburn.
8) Or equal.

2. Ground Wells:

a. Christy Concrete Products, Inc.

b. Forni Corp.

c. Or equal.

3. Ground Bushings, Connectors, Jumpers and Bus:
   a. O-Z/Gedney.
   b. Thomas & Betts Corp.
   c. Or equal.
4. Compression Connector Lug
   a. Panduit
   b. B-Line SB-479 Series
   c. Thomas & Betts
   d. Or equal.
5. Telecommunications Ground Bus Bar
   a. Description:
      1) Meets EIA/TIA 607.
      2) Provide compression-type lugs.
      3) Material:
         a) ASTM A36 structural steel.
         b) ASTM B187-C11000 copper bar.
         c) Polyster resin fiberglass insulator.
         d) Steel – Yellow Finish.
         e) At least 20 inches wide.
         f) Wall Mountable.
   b. Manufacturer:
      1) B-Line SBTMGB20
      2) CPI 40153-020
      3) Or Equal.
6. Rack and Cabinet Grounding
   a. Panduit Structured Ground Kit
   b. Chatsworth Products Inc.
   c. or equal.
7. Bonding Ribbon:
   a. Annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated.
   b. Manufacturer:
      1) Inwesco 12A55
      2) Corning Cable Systems
      3) Preformed Line Products.
      4) or equal.
8. Bonding Ribbon Clamp:
   a. Soft lead

b. 1/16 inch thick

c. Bolt hole for attachment

d. Manufacturer:
   1) Inwesco 12A56
   2) Corning Cable Systems
   3) Preformed Line Products.
   4) Or equal.

9. Fargo Clamp:

   a. Cast copper, silver plated, furnished with copper bolt.

   b. RUS Listed

   c. Manufacturer:
      1) Allied Bolt
      2) Inwesco 12A57
      3) Corning Cable Systems
      4) or equal.

10. Ground Inserts:

   a. Cast Bronze w 1/4 Copper Rod.

   b. Provide minimum one each maintenance hole or vault.

   c. Manufacturer:
      1) Inwesco 12H69
      2) or equal by vault or manhole manufacturer.
      3) or equal.

2.2 GROUND CONDUCTORS

A. General purpose insulated:

1. NRTL listed and code sized copper conductor, with dual rated THHN/THWN insulation, color solid green. The jacket may have a yellow stripe.

2. The jacket shall include markings that indicate conductor, manufacturer, and NRTL listing.

3. Minimum wire size is #6 AWG UON. Grounding conductors larger than 4 AWG (5 mm) shall be stranded. Use solid conductors for 4 AWG (5 mm) and smaller.

4. Use stranded grounding conductors at locations subject to vibration or repeated flexing, regardless of size.

5. Where continuous color-coded conductors are not commercially available, provide a minimum 4 in. long color band with green, non-aging, plastic tape in accordance with NEC. The band shall be located within 152 mm (6 in.) of each termination and splice and at 1.2 m (4 ft.) intervals along its run.

6. Plenum rated, if run in plenum spaces.

B. Telecommunications Bonding Backbone (TBB)

1. A TBB shall be provided between the TMGB and each TGB.
2. The TBB shall be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 168 kcmil (No. 3/0 AWG; 12 mm).

C. Bonding Conductor for Telecommunications (BCT)

1. A BCT shall be provided between each TMGB and the building's service equipment (power) ground.
2. The BCT shall be the same size as, or larger than, the largest TBB.

D. Rack Bonding Conductor (RBC)

1. A separate RBC shall be provided between each cabinet or rack and the TGB or TMGB in the room.
2. Each RBC shall be sized as a 6 AWG (4 mm).

E. Unit Bonding Conductor (UBC)

1. Separate UBCs shall be provided for each piece of active equipment in a rack/cabinet that has a ground connection point separate from its power source.
2. The UBCs shall be connected between the active equipment and the RGB of the cabinet/rack.
3. The UBC shall be a minimum 12 AWG (2 mm).

F. Bonding Jumpers

1. Bonding jumpers shall be used wherever two metallic parts meet in an electrically insecure connection. Examples include, without limitation, cable tray sections and cabinet or rack components and doors.
2. Bonding jumpers shall be factory pre-terminated.

G. Outside Plant Applications

1. Grounding conductors shall be bare copper, meeting ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

H. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provided with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.

2.3 COMPRESSION CONNECTOR LUG

A. Description

1. Connector lug with compression connection to conductor.
2. Copper alloy body.
3. Provide lug size to match conductor being terminated.

4. Provide 2 hole pattern lugs.

5. Provide each lug with silicon bronze hardware, including 2 bolts, 2 split lock washers and 2 nuts.

2.4 INSULATED GROUNDING BUSHINGS

A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

2.5 CONNECTIONS TO PIPE

A. For cable to pipe: UL listed bolted connection complying with CEC requirements.

2.6 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

A. Where required by the Drawings or Specifications, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.

B. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld, Thermoweld or equal. Each particular type of weld shall use a kit unique to that type of weld.

C. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series, Burndy “Hy-Ground” or equal.

2.7 EXTRA FLEXIBLE, FLAT BONDING JUMPERS

A. Where required by the drawing or specified herein.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide Grounding and Bonding according to the most restrictive requirements of:

1. ANSI-J-STD-607-B-2011.

2. California Electrical Code Article 250 and references therein.

3. California Electrical Code Article 800.

B. In the event of conflicting requirements, California Electrical Code requirements shall prevail.

3.2 BONDED COMPONENTS:

A. Bonding conductors or jumpers are to be installed within each Telecommunications Space between the TMGB/TGB and the following components:

1. The communications building entrance protectors.
2. Metallic shielding of outside cable plant.
3. Metallic shielding of inside cables, where required by Code.
4. Electrical panel board (if in the same room as TMGB/TGB).
5. Building steel (if accessible in the same room as TMGB/TGB or close by external to the room).
6. Telecommunications ladder rack and cable tray.
7. Telecommunications equipment racks and cabinets via the RGBs.
8. Wall-mounted metallic enclosures.
9. Metallic conduit longer that 1 m (3 ft.) and not secured to a grounded enclosure in an electrically continuous manner.
10. Access floor systems.

B. Where a metallic raceway connects two or more Telecommunications Spaces, bond to the Telecommunications Ground Busbar at each end

C. Point of Connection

1. Under Work of this Section, make connections to Communications Ground Busbars provided under Work of Division 26, or by separate project, as applies.

D. Grounding Busbars

1. Install busbars per manufacturer's instructions and at locations shown on the plans. If locations are unclear, apply for and conform to direction from the University's Representative.
2. Locate all busbars so that they are accessible to telecommunications personnel, yet not exposed to casual contact. Other cable types must not be allowed to contact the busbars or pass within 152 mm (6 in.) of the busbar.
    a. TMGBs and TGBs shall be located on or near the wall opposite the entrance, at least 2.1 m (7 ft.) above finished floor (AFF).
    b. RGBs shall be located on the rear of the cabinet/rack. Horizontal RGBs shall be as near the top of the rails as space allows. Vertical RGBs shall be used only in closed cabinets.

E. TMGB

1. The TMGB shall be bonded directly to the closest point of the building's earth grounding electrode system and to building steel. Building steel should be tested to verify its ground conductivity to earth.
2. All metallic raceways for telecommunications cabling located within the same room or space as the TMGB shall be bonded to the TMGB.
3. Insulate the TMGB 51 mm (2") from the wall.
4. For outside plant cables entering a building with a cable shield isolation gap, bond the cable shield (on the building side of the gap) to the TMGB. Outside plant protectors shall be bonded to the TMGB with a No. 4 AWG (5 mm) conductor.
5. Connections to the busbar shall be made with 2-hole lugs.
6. Connections shall be made by cleaning the area of connection on the busbar and on the two-hole lug and then applying a thin coating of anti-oxidant compound.

F. TGB

1. The TGB shall be bonded directly to the TMGB and to building steel. Building steel should be tested to verify its ground conductivity to earth.
2. All metallic racks, cabinets, enclosures and raceways for telecommunications cabling located within the same room or space as the TGB shall be bonded to the TGB.
3. Insulate the TGB 51 mm (2") from the wall.
4. Connections to the busbar shall be made with 2-hole lugs.
5. Connections shall be made by cleaning the area of connection on the busbar and on the two-hole lug and then applying a thin coating of anti-oxidant compound.

G. RGB

1. An RGB shall be installed on/in all racks and cabinets.
   a. The paint or other coating of the cabinet/rack shall be removed and the bare metal cleaned around each point where the RGB contacts the cabinet/rack.
   b. A thin coating of anti-oxidant compound shall then be applied to the contact points before the RGB is bolted down.
   c. The mounting screws should be of the thread-forming type, not self-tapping or sheet metal screws, if possible.
2. Each RGB shall be bonded to the TGB or TMGB in the same room with a dedicated RBC.
   a. Each piece of active equipment in a rack/cabinet that has a ground connection point separate from its power source shall be bonded to the RGB.

H. Routing

1. Bonding conductors shall be routed in as direct a route as possible to the point of termination while adhering to the following: No bonding conductor shall vertically traverse a wall except at wall corners.
2. Must not be daisy-chained among equipment, racks or pathways.
3. Shall have no twists, loops or sharp bends. Conductors shall be routed with smooth wide bends.
4. Should not be spliced. When necessary, use an approved Listed connection and position it in an accessible location.
5. Must be protected from physical damage, by its location or with a non-metallic barrier.
6. Should not be placed in metallic conduit. If it is necessary to place grounding and bonding conductors in metallic conduit that exceeds 1 m (3 ft) in length, the conduit must be grounded at both ends to the same ground point as the conductor.
7. Jacketed conductors run in plenum spaces must be plenum rated.
8. The maximum current on any grounding conductor under normal operation should be less than 1A AC and 500mA DC.
9. Shall be sized per code, depending on the length.

I. Mechanical Connections

1. Except where a manufacturer provided grounding lug is provided, the paint or other coating of the component (rack, cabinet, cable tray, etc.) shall be removed and the bare metal cleaned around each point where a conductor lug is connected.
2. A thin coating of anti-oxidant compound shall then be applied to the contact points before the lug is bolted down.
3. Mounting screws should be of the thread-forming type, not self-tapping or sheet metal screws.
4. Cable trays and conduit shall not be used as a grounding conductor, even if they are so rated.
5. Clean ground bars prior to terminating bonding conductors.
6. Torque threaded fasteners to manufacturer’s recommended values.

J. Bonding Jumpers

1. Install manufacturer’s bonding clips, plates or bonding jumpers:
2. Across the joint where sections of cable tray (mesh or ladder) meet.
3. Between a cabinet’s door and its frame.

4. Between all other separate panels of a cabinet and the frame; such as the top, bottom & side panels and air ducting baffles.

5. Across all frame joints of cabinets and racks, unless the cabinet/rack is factory welded and fully assembled on arrival.

K. Cabinet and Rack Continuity

1. As an alternative to using jumpers across all separate parts and frame joints of a cabinet/rack, one of the following options may be used.

2. Remove the paint or other coating of both parts being joined to create a bare metal area at least the same diameter as the bolt head. Clean both bare metal areas and apply a thin coating of anti-oxidant compound before connecting the parts.

3. Use aggressive Type “B” internal-external tooth lock washers. Torque the bolts per manufacturer’s instructions to create an acceptable bond. Two washers are necessary to accomplish this: one under the bolt head contacting and cutting paint and one under the nut.

L. Grounding Lugs

1. Wires shall be inserted to the full depth of the lug.

2. Space between wire insulation and the body of the compression lug shall be kept to a maximum of 3 mm (1/8 in.)

3. Lug must be sized with wire size.

4. To assure proper die is used with the specified connector, manufacturer's embossed coding systems shall be adhered to.

5. Connectors shall not be modified in any way.

6. Daisy chaining and stacking (piggy backing) of ground lugs is prohibited.

7. Bolts, nuts and washers used to secure ground connections shall match the diameter of the hole.

8. Make compression connections with the lug or fitting manufacturer’s recommended tooling, with the tooling set to the recommended force and stroke.

M. Cable Tray and Cable Runway

1. Coordinate with the Work of Section 27 05 36 – Cable Trays for Communications Systems

2. Provide manufacturer’s bonding clips, plates or jumpers as required to comply with the UL Classified conditions for use as an equipment grounding conductor.

3. Bond the Cable Runway to the Communications Ground Busbar at the Communications Room served.

N. Cable Shields

1. Comply with California Electrical Code Article 800.

O. Protector Fields

1. Comply with California Electrical Code Article 800.

P. Emergency/Information Telephone enclosures

1. Bond as detailed on Communications Drawings.

Q. Communications Broadband Systems

1. Comply with California Electrical Code Article 820.
2. Ground Broadband passives as shown on Communications Drawings.

3.3 LABELING

A. All labels shall be permanent, computer-generated and nonmetallic, printed with wording in high contrast to the background. Comply with Section 27 05 53 - Identification for Communications Systems.

B. Each telecommunications bonding conductor shall be labeled as close as practicable to its point of termination in a readable position. Labels shall have:

1. The statement, “If this connector or cable is loose or must be removed, please call the building telecommunications manager”.
2. An identification label providing the source and destination of the grounding conductor.
3. Conductors contained completely within one room need not have the source and destination label.
4. Instead, label the busbar at each connection with the name of bonded equipment (rack, tray, etc.) connected at that point.

C. The BCT, or the conduit containing it, shall be labeled:

1. At the TMGB with tag or adhesive label that states “Building Conductor for Telecommunications (BCT) to Main Electrical Service Ground Connection”.
2. At the main electrical service ground connection with tag or adhesive label that states “Building Conductor for Telecommunications (BCT) to Telecommunications Main Grounding Busbar (TMGB)”.

3.4 TESTING

A. All grounding connections shall be tested for continuity and resistance after installation but prior to substantial completion. The telecommunications contractor is to invite the University’s Representative to witness a portion of this testing while it is being performed.

B. The test performed shall use an earth ground resistance tester that is configured for a continuity test, otherwise known as a two-point test or a “dead earth” test. Tests shall be conducted between the electrical entrance ground and the TMGB as well as at each TGB. This resistance shall be less than 0.05 Ohms.

3.5 GROUNDING AND BONDING OUTSIDE CABLE PLANT (OSP)

A. Underground Communications Structure Ground Rods

1. Ground rods shall be installed at new communications handholes, vaults and pullboxes installed by the work of this Project. A ground rod shall be installed at new communications handholes, vaults, manholes and pullboxes installed by the work of this Project, or at existing underground structures used by the work of this Project lacking a ground rod.

   a. Provide two ground rods at maintenance holes.

   b. Elsewhere provide one ground rod.

2. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3. Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths.

   a. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations.

   b. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

B. Underground Cable Bonding

1. Cables used in underground conduit systems have either an outer metallic sheath or a plastic sheath. Cables with an outer metallic sheath shall be bonded at each Maintenance Hole (MH). Cables with an outer plastic sheath shall be bonded at MHs where a splice is made. When using OSP cable for a LAN drop, splices should not be made.

END OF SECTION 27 05 26

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the provision of communications supports and cable hook system as described in this specification, including but not limited to:

1. Strut supports
2. Cable Hooks (J-hooks)
3. Beam clamps
4. Concrete Fasteners
5. Touch-Up Materials
6. Conduit supports.
7. Equipment supports.
8. Fastening hardware.

B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1. Section 27 05 00 – Common Work Results for Communications
2. Section 27 05 33 – Conduits and Backboxes for Communications Systems
3. Section 27 05 53 – Identification for Communications Systems
4. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
5. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
6. Section 27 11 23 – Communications Cable Management
7. Section 27 15 00 – Communications Horizontal Cabling

1.2 SYSTEM DESCRIPTION

A. Provide devices specified in this Section and related Sections for support of communications equipment specified for this Project.

B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

1.3 REFERENCES

A. American Society For Testing and Materials (ASTM)

1. ASTM A123/A123M-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2. ASTM A153/A153M-04 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

3. ASTM B633-98e1 Specification for Electro-deposited Coatings of Zinc on Iron and Steel.

4. ASTM A653/A653M-04a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. American National Standards Institute (ANSI)

1. ANSI/TIA/EIA-568-B.1-2001, Commercial Building Telecommunications Cabling Standard – Part1: General Requirements

2. ANSI/TIA/EIA-568-B.2-2001, Commercial Building Telecommunications Cabling Standard – Part2: Balanced Twisted Pair Cabling Components

3. ANSI/TIA/EIA-568-B.3-2000, Optical Fiber Cabling Components Standard

4. ANSI/ TIA/ EIA 569-B Commercial Building Standard for Telecommunications Pathways and Spaces

C. National Fire Protection Association

1. NFPA 70, National Electrical Code

1.4 SUBMITTALS

A. Conform with the following:

1. As part of the project submittals, the contractor to provide engineered shop drawings indicating the proposed design for mounting all work of this Division weighing more than 20 pounds, inclusive of mounting systems, and for equipment mounted at the exterior, inclusive of its effective wind load under conditions the range of conditions experience

a. Shop drawings to be accompanied by anchorage calculations indicating that it shall remain attached to the mounting surface after experiencing forces in conformance with CCR, Title 24, Table 23P, Part II and with Section 2312 "Earthquake Regulations" of the "Uniform Building Code" for Seismic Zone 4 Area, Importance Factor of 1.25.

b. Structural Calculations shall be prepared and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.

2. Interior Paints and Coatings:

a. Manufacturers' product data and material safety data sheets (MSDS) for paints and coatings used on the interior of the building including printed statement of VOC Content in g/L.

1.5 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.

B. Cable hooks shall be listed and labeled by Underwriters Laboratories (UL) as required.

C. Cable hooks shall have the manufacturers name and part number stamped in the part itself for identification.

PART 2 - PRODUCTS

2.1 GENERAL

A. Interior Paints and Coatings:

1. For interior applications use paints and coatings that comply with Green Seal's Standard GS-11, summarized by the following upper limits for VOC Content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:

Flat Paints and Coatings	50 g/L	Waterproofing Sealers	250 g/L
Non-Flat Paints and Coatings	150 g/L	Sanding Sealants	275 g/L
Anti-Corrosive Coatings	250 g/L	All other Sealants	200 g/L
Clear Wood Finishes: Varnishes	350 g/L	Stains	250 g/L
Floor Coatings	100 g/L	Clear Shellacs	730 g/L
Paint Primer	150 g/L	Pigmented Shellacs	55 g/L

2.2 SUPPORTING DEVICES

A. General

1. Supports to be sized to suit load and selected to match mounting conditions

B. Manufacturers

1. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:

a. Concrete fasteners:
1) Phillips "Red-Head".
2) Remington.
3) Ramset.
4) Hilti
5) Simpson Strong-Tie

6) or equal.

b. Concrete inserts and construction channel:
   1) Unistrut Corp.
   2) GS Metals "Globe Strut."
   3) Thomas & Betts "Kindorf" Corp.
   4) Or equal.

c. Conduit straps:
   1) O-Z/Gedney.
   2) Erico "Caddy" Fastening Products.
   3) Thomas & Betts "Kindorf" Corp.
   4) Or equal.

d. Beam Clamps
   1) Cooper B-Line
   2) SuperStrut
   3) Unistrut
   4) or equal

e. Aircraft Cable Sway Braces
   1) Mason Industries
   2) M.W. Sausse/Vibrex
   3) Loos & Company, Inc.
   4) or equal.

C. Concrete Fasteners

1. Provide expansion-shield type concrete anchors.

2. Provide powder driven concrete fasteners with washers. Obtain approval by Owner's Representative prior to use.

D. Concrete Inserts

1. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of ¼ inch to ½ inch diameter thread for rod support.

E. Aircraft cable sway braces

1. Steel rope sized to meet load.

F. Construction Channel:

1. Construction:

   a. 1-5/8 in. square galvanized channel formed from U.S.S.G No. 12 or 0.109 inch cold formed steel with 17/32-inch diameter bolt holes, and 1-1/2 inch on center in the base of the channel.

   b. 10 foot sections.

2. All supporting materials by same manufacturer.

G. Beam Clamps

1. Malleable iron electro-galvanized steel beam clamps selected to match building structural steel members.

H. Conduit Straps

1. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
   a. Use malleable strap with spacers for exterior and wet locations.
   b. Use steel strap without spacers for interior locations.
2. Steel channel conduit strap for support from construction channel.
3. Steel conduit hanger for pendant support with threaded rod
4. Steel wire conduit support strap for support from independent #12 gauge hanger wires.

I. Threaded rods, couplings, screws and nuts:

1. Electrolytically coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.

J. Miscellaneous Parts

1. Hot dipped galvanized after fabrication; after cutting, de-burring and hole drilling. Coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.

K. Paint/Tape for Touch-up:

1. Zinc: CRC "Zinc-It", Glyptal, Enterprise Galvanizing “Galambra”, or equal.

2.3 CABLE HANGERS

A. Ceiling Hung J-Hooks

1. Drawing Reference(s):
   a. WMJ
   b. ACJ
2. Features/Functions/Construction
   a. Specifically intended to carry the load of up to 50 communications cables without applying excess forces to cables at bottom of bundle.
   b. Integral broad bottom edge to spread cable load with flat bottom and provide a minimum of 1-5/8 inch cable bearing surface.
   c. Integral hanger rod attachment hardware at top.
   d. Load rated for application.

e. Incorporates smooth 90-degree radiused edges to prevent snagging cable jackets on installation.

f. Designed so the mounting hardware is recessed to prevent cable damage.

g. Integral mechanical cable latch retainer to provide containment of cables within the hook. The retainer shall be removable and reusable.

h. Suitable for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.

i. Multi-tiered cable hooks to be used where required to provide separate cabling compartments, or where additional capacity is needed.

j. Finishes:
   1) Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.
   2) Cable hooks for corrosive areas shall be stainless steel, AISI Type 304.

3. Manufacturer

   a. Cooper B-Line series BCH21, BCH32, BCH64

   b. Caddy/Erico CableCat

   c. or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. The Owner's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the Owner.

3.2 EXAMINATION

A. Thoroughly examine site conditions for acceptance of supporting device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.3 PREPARATION

A. Coordinate size, shape and location of concrete pads required for equipment installation with Base Building General Contractor.

B. Layout support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.

C. Where shown on the Drawings or Specifications, install freestanding communications equipment on concrete pads.

3.4 INSTALLATION

A. Furnish and install supporting devices as noted throughout the Communications Systems work.

B. Communications device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.

C. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using precast inserts, expansion anchors, preset inserts or beam clamps.

D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster or gypsum board partitions and walls.

E. Use expansion anchors or preset inserts in solid masonry walls.

F. Use self-drilling anchors, expansion anchor, or preset inserts on concrete surfaces.

G. Use sheet metal screws in sheet metal studs and wood screws in wood construction.

H. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or acoustical ceiling suspension wires.

I. Do not drill structural steel members unless first approved in writing by the Owner's Representative.

J. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

K. Install surface-mounted cabinets with minimum of four anchors. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.

L. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

3.5 ERECTION OF METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.6 WOOD SUPPORTS

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.7 DISTRIBUTION PATHWAY VIA CEILING HUNG CABLE HOOKS (J-HOOKS):

A. Void, Plenum or Suspended Ceiling Exposed Cable Installation. Where drawings specifically show or permit use of exposed cable installation in voids, conform to the most restrictive requirements of Code, TIA-569-B and this Section.

B. Provide support for all cabling. Do not place or attach directly to T-bar grid, concealed spline grid, flexible or rigid ductwork, HVAC registers, sprinkler piping or fixtures, light fixtures or building structure. Conform to the California Electric Code.

C. Placement:

1. All pathways created by ceiling hung cable hooks shall be reviewed by the Owner's Representative prior to installation.

2. Ceiling hung cable hooks and cabling supported by same shall not obscure access to access doors, hatches, air dampers, valves, filter sections, VAV boxes, cable trays, junction boxes, pull boxes or similar areas of access required by other trades.

3. All ceiling hung cable hooks shall be mounted close enough together such that upon completion of the station cable installation a minimum amount of cable droop occurs between adjacent rings. The distance between supporting rings shall not exceed 48 inches or as required by the current edition of TIA-569-B.

4. Refer to the separation requirements listed in Section 27 15 00 – Communications Horizontal Cabling for minimum distances from electrical power and other electro-magnetic sources.

D. Follow manufacturer's recommendations for allowable fill capacity for each size of cable hook.

1. Cable hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.

2. Spring steel cable hooks shall be capable of supporting a minimum of 100 pounds with a safety factor of 3 where extra strength is required.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Provide telecommunications pathways in accordance with EIA TIA/EIA-569-B, as specified in this Section and as shown on the plans. Provide system furniture pathways in accordance with UL 1286. Provision of all low voltage Communications Systems Pathway and Electronic Security and Safety System Pathway, including:

1. Rigid steel conduit and fittings.
2. PVC insulated rigid steel conduit and fittings.
3. Intermediate metal conduit and fittings.
4. Electrical metallic tubing and fittings.
5. Flexible metallic conduit and fittings.
6. Liquidtight flexible metallic conduit and fittings.
7. Miscellaneous conduit fittings and products.
8. Junction Boxes
9. Floor Boxes
10. Hinged cover enclosures.
11. Pullboxes and Terminal Cabinets.

B. At Hazardous Occupancies, installation conforms to the requirements of California Electric Code for Class and Division rating of spaces.

1.2 RELATED WORK IN OTHER SECTIONS:

A. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1. Section 27 05 00 – Common Work Results for Communications.
2. Section 27 05 29 – Hangers and Supports for Communications Systems
3. Section 27 05 33 – Conduits and Backboxes for Communications Systems
4. Section 27 05 36 – Cable Trays for Communications Systems
5. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
6. Section 27 15 00 – Communications Horizontal Cabling

1.3 REFERENCES

A. Usage:

1. American National Standards Institute (ANSI)
   a. ANSI C80.1 1994 Rigid Steel Conduit - Zinc Coated
   b. ANSI C80.3 1991 Electrical Metallic Tubing - Zinc Coated
2. National Electrical Manufacturers Association (NEMA)
   a. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)
   b. NEMA FB 1 (ANSI/NEMA FB 1-2003) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
   c. FB 2.10 2000 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).
   d. FB 2.20 2000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
   e. NEMA ICS 6 1988 (Rev. 1) Enclosures for Industrial Control and Systems
   f. NEMA OS 3-2002 Selection and Installation Guidelines for Electrical Outlet Boxes.
   g. NEMA RN 1-1998 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   h. NEMA TC 7 2000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct
   i. NEMA TC 13 2000 Electrical Nonmetallic Tubing (ENT).
   j. NEMA TC 14 1984(R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
3. Underwriters Laboratories, Inc. (UL)
   a. UL 1 2000 Flexible Metal Conduit
   b. UL 6 2004 Electrical Rigid Metal Conduit - Steel
   c. UL 50 (1995; R 1999, Bul. 2001) Enclosures for Electrical Equipment
   d. UL 360 1986 (Bul. 1991) (R 1993) Liquid-Tight Flexible Steel Conduit
   e. UL 514A 1991 (R 2004) Metallic Outlet Boxes
   f. UL 514B 1989 (R 2004) Conduit, Tubing and Cable Fittings
   g. UL 514C 1996 (R 2000) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
   h. UL 651 1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit.
   i. UL 797 1993 (R 2004) Electrical Metallic Tubing - Steel

j. UL 12421983 (R1993) (Bul. 1993) Intermediate Metal Conduit.

k. UL 1286(1999; R 2001, Bul. 2002) Office Furnishings

l. UL 1479 Fire Tests of Through Penetration Firestops

m. UL Fire Resistance Directories

1.4 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.

B. Only products and applications listed in this Section may be used on the project unless otherwise submitted and approved by the Architect.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide the following types of conduit systems listed by their commonly used generic name.

2.2 RACEWAY

A. Manufacturers:

1. Raceway:
   a. Allied Tube and Conduit Co.
   b. Triangle PWC, Inc.
   c. Western Tube and Conduit Corp.
   d. Spring City Electrical Manufacturing Co.
   e. Occidental Coating Co. (OCAL).
   f. Alflex Corp.
   g. American Flexible Metal Conduit Co.
   h. Anaconda.
   i. Or equal.
2. Fittings:
   a. Appleton Electric Co.
   b. OZ/Gedney.
   c. Thomas & Betts Corp.
   d. Spring City Electrical Manufacturing Co.
   e. Occidental Coating Co. (OCAL).

f. Carlon.

g. or equal.

B. Rigid Steel Conduit.

1. Drawing and Spec Reference: RSC.

2. Construction:

a. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.

b. Standard threaded couplings, locknuts, bushings, and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure.

c. Three piece couplings: Electroplated, cast malleable iron.

d. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150 degree C minimum.

e. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.

f. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150 degrees C.

g. All fittings and connectors shall be threaded.

C. Coated Rigid Steel Conduit:

1. Drawing and Spec Reference: CRSC.

2. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.

3. Fittings:

a. Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory PVC coated with an insulating jacket equivalent to that of the coated material.

b. Fittings over-sleeve to extend 1 conduit diameter or 1-1/2 in. beyond fitting, whichever is less.

4. Performance:

a. Tensile Strength: 3500 psi.

5. Approvals:

a. NEMA RN1 (Type 40 - 40 mils thick)

b. CalTrans Type 2

6. Manufacturers:

a. Plastibond by RobRoy Industries.

b. Occal-40 by Occidental Coating Company.

c. KorKap by Plastic Applicators.

d. Ocal-Blue

e. or equal.

D. Intermediate Metal Conduit

1. Drawing Reference: IMC

2. Conduit: Hot dip galvanized steel meeting the requirements of CEC Article 345 and conforming to ANSI C80.6 and UL 1242.

3. Fittings: Conduit couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.

E. Electrical Metallic Tubing.

1. Drawing and Spec Reference: EMT.

2. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 specifications and shall meet UL classifications.

3. Set screw type couplings: Electroplated, steel or cast malleable iron, UL listed concrete tight. Use set screw type couplings with four setscrews each of conduit sizes over 2 inches. Setscrews shall be of case hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.

4. Set screw type connectors: Electroplated steel or cast malleable iron UL listed concrete tight with male hub and insulated plastic throat, 150 degree C temperature rated. Setscrew shall be same as for couplings.

5. Raintight couplings: Electroplate steel or cast malleable iron; UL listed raintight and concrete tight, using gland and ring compression type construction.

6. Raintight connectors: Electroplated steel or cast malleable iron, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.

F. Flexible Conduit:

1. Drawing Reference: FLEX

2. Construction:

a. Flexible steel, zinc coated on both inside and outside by hot-dipping process.

b. Interlocking spirally wound continuous steel strip.

c. 3/4 in. minimum size.

3. Fittings: Connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Exception: Pressure cast screw-in connectors shall be acceptable for fixture connection in suspended ceilings and cut-in outlet boxes within existing furred walls.

4. Approvals:

   a. UL 1

G. Liquidtight Flexible Metallic Conduit

1. Drawing Reference: Liquidtight

2. Conduit: Shall be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquidtight jacket of polyvinyl chloride (PVC) and conforming to UL 360. Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.

3. Fittings: Connector body and gland nut shall be of cadmium plated steel or cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "O" ring gasket recessed into the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

2.3 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

A. General

1. UL 514B.

2. Listed in UL Electrical Construction Materials List.

B. Conduit Fittings, Insulated Throat Grounding Bushings

1. Description

   a. Threaded for Rigid Steel Conduit and Intermediate Metal Conduit.

   b. UL Listed for use with copper conductors.

   c. Thermoplastic insulated liner for 105 degrees Celsius.

   d. Body of malleable iron, zinc plated; or die cast zinc.

2. Manufacturer

   a. Thomas & Betts (Steel City) BG-801 Series

   b. O-Z/Gedney

   c. or equal.

C. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.

D. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.

E. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4 in. conduit movement (2 in. in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.

F. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514.

1. Manufacturer:
    a. OZ/Gedney Type DX
    b. Steel City Type EDF
    c. or equal.

G. Fire rated penetration seals:

1. UL classified.
2. Conduit penetrations in fire rated separation shall be sealed with a UL classified assembly consisting of fill, void or cavity materials.
3. The fire rated sealant material shall be the product best suited for each type of penetration, and may be a caulk, putty, composite sheet or wrap/strip.
4. Penetrations of rated floors shall be sealed with an assembly having both F and T ratings at least equal to rating of the floor.
5. Penetrations of rated walls shall be sealed with an assembly having an F rating at least equal to the rating of the wall.

H. Standard products not herein specified:

1. Submit for review a listing of standard electrical conduit hardware and fittings not herein specified prior to use or installation, i.e. locknuts, bushings, etc.
2. Listing shall include manufacturers name, part numbers, and a written description of the item indicating type of material and construction.
3. Miscellaneous components shall be equal in quality, material, and construction to similar items herein specified.

I. Hazardous area fittings: UL listed for the application.

2.4 JUNCTION AND DEVICE BOXES

A. Junction and Device Boxes

1. Drawing References: As shown on Symbol Schedule
2. Construction:
   a. Concealed/Flush Mounted:
   b. One or two piece welded knockout boxes.
   c. UL 514A, cadmium or zinc-coated 1.25 oz/sq. ft., if ferrous metal.
   d. Pressed sheet steel, for indoor locations.
   e. UL 514C approved if non-metallic.
   f. At hollow masonry, tile walls and plaster walls, provide with device rings as required.
   g. Surface mounted:
      1) Exterior - Conform to the Junction and/or PullBox construction scheduled on the Plans. Where construction not otherwise scheduled or noted on the plans, conform to the following.:
         a) Cast iron or aluminum with threaded hubs and mounting lugs.
         b) Gasketed cover with spring lid.
      2) Concrete floor embedded:
         a) Cast iron concrete pour boxes with screwed brass cover, unless otherwise noted.
         b) Cadmium plated screw cover attachment at least 6 in. on center.
   h. If size not otherwise noted, at least 4S (4 in. square) by 2-1/8 in. deep, or Code minimum size, whichever is larger.
      1) Wherever 4S is indicated, contractor may at their option substitute 4-11/16 in. square boxes while maintaining the minimum depth required by these specifications and the drawings.
      2) At recessed masonry wall installations, provide gangable masonry boxes.
   i. Provide complete with approved type of connectors and required accessories, including attachment lugs or hangers. Provide raised device covers as required to accept scheduled device.
3. Approvals.
   a. UL 514A
4. Manufacturers:
   a. Interior:
      1) Steel City.
      2) Bowers
      3) or equal.
   b. Exterior, exposed with cover of same construction.
      1) Appleton

2) Pyle-National
3) or equal.

c. Other conditions:
1) Any meeting approvals and requirements.

B. Flat Panel Wall Box (framed wall condition)

1. Drawing Reference: FPWB

2. Features, functions and construction:

a. Box provides means to install audiovisual, network and power receptacles flush in wall behind flat-panel display. With box cover installed, connectors are concealed and cables, both power and communications pass through slot at base of cover plate into connection points on back of flat-panel.

b. Cover plate protrudes less than 1/2 in. from face of wall.

c. 16 gauge box construction with 1/16 in. inch thick minimum cover plate, white finish baked enamel or powder coat, field paintable

d. Box incorporates provisions to mount up to two electrical device boxes for provision of duplex power receptacles either from above or below.

e. Additionally box mounts manufacturers low-voltage conduit entry box which accommodates manufacturer's line of audiovisual connector inserts. Design of FPWB permits installation of up to two low-voltage conduit entry boxes, which may be mounted either above or below the FPWB.

f. Manufacturers audiovisual insert line shall support at least the following receptacles:
1) BNC, in combinations of 1 to 5 BNC's, color-coded for composite, component analog and RGBHV video formats, as required.
2) RCA, in combinations of 1 to 3 RCA's color-coded for Composite and component analog video formats, as required.
3) S-Video.
4) XLR, 3 and 4 pin.
5) DB-15
6) DB-9
7) Neutrik Speakon.
8) DVI
9) HDMI
10) 1/4 in. and mini TRS.

g. Provide with manufacturer's connector inserts as required to terminate cabling types and applications indicated on the single-line diagrams. Punch blank panel inserts and provide other receptacle types as required or indicated to fulfill the requirements of the contract documents. Fill remaining openings with blank inserts.

3. Manufacturers:

a. FSR Inc. PWB-100

b. Or equal (No known equal).

C. Flat Panel Wall Box (concrete wall condition)

1. Drawing Reference: FPWB2

2. Features, functions and construction:

a. Box provides means to install audiovisual, network and power receptacles flush in wall behind flat-panel display. With box cover installed, connectors are concealed and cables, both power and communications pass through slot in cover plate into connection points on back of flat-panel.

b. Cover plate protrudes less than 1/2 in. from face of wall.

c. 16 gauge box construction with 1/16 in. inch thick minimum cover plate, white finish baked enamel or powder coat, field paintable

d. Box incorporates provisions to mount up to two electrical device boxes for provision of duplex power receptacles.

e. Additionally box mounts manufacturers low-voltage conduit entry box which accommodates manufacturer's line of audiovisual connector inserts. Design of FPWB2 permits installation of up to two low-voltage conduit entry boxes, which may be mounted within the FPWB.

f. Manufacturers audiovisual insert line shall support at least the following receptacles:
1) BNC, in combinations of 1 to 5 BNC's, color-coded for composite, component analog and RGBHV video formats, as required.
2) RCA, in combinations of 1 to 3 RCA's color-coded for Composite and component analog video formats, as required.
3) S-Video.
4) XLR, 3 and 4 pin.
5) DB-15
6) DB-9
7) Neutrik Speakon.
8) DVI
9) HDMI
10) 1/4 in. and mini TRS.

g. Provide with manufacturer's connector inserts as required to terminate cabling types and applications indicated on the single-line diagrams. Punch blank panel inserts and provide other receptacle types as required or indicated to fulfill the requirements of the contract documents. Fill remaining openings with blank inserts.

3. Manufacturers:

a. FSR Inc. PWB-CMU8-B with PWB-CMU8-WHT-C cover

b. Or equal (No known equal).

2.5 CABINETS AND ENCLOSURES

A. Terminal Cabinets:

1. Drawing Reference: As Scheduled.

2. Construction:

   a. Zinc Coated Sheet Steel, code gauge with standard concentric knockouts for conduit terminations.

   b. Interior dimensions not less than those scheduled.

   c. Finish: Manufacturer's standard gray baked enamel finish.

   d. Covers: Trim fitted, continuous hinged steel door, flush catch – lockable and keyed to match. Screw fastened doors not acceptable.
      1) Door face to be not less than 95% of panel interior dimensions.

   e. Provide with 3/4 in. fire retardant treated ply backboard.

3. Mounting:

   a. Flush cabinets shall be furnished with concealed trim clamps and shall be not less than 4 inches deep.

   b. Surface cabinets shall be furnished with screw cover trim, flush hinged door and shall not be less than 6 inches deep.

   c. Interior Applications:
      1) NEMA 250 Type 1, unless otherwise noted. Refer to plans and schedules.

   d. Exterior Applications:
      1) NEMA 250 Type - As Scheduled, not less than NEMA 3R.

4. Manufacturers:

   a. B-Line Electrical Enclosures

   b. Circle AW Products.

   c. Hammond

   d. Henessey.

   e. Hoffman.

   f. Myers Electric Products

   g. Rittal.

   h. or equal.

2.6 FLOOR BOXES, POKE-THROUGHS AND MONUMENTS

A. Floor Box, Cast Iron, Recessed Devices, with Lid Designed to meet UL Scrub Water Listing
   1. Drawing Reference: FC4
   2. Construction
      a. Use in above grade and on-grade floor applications.
      b. Boxes shall have the ability to accept a component that will allow the box to be installed in polished concrete or terrazzo floors.

c. Boxes shall be painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and be approved for use on-grade and above grade floors.
d. Dimension: 15-1/8" L x 11-3/16" W x 6" H
e. Eight (8) independent wiring compartments that allow for up to eight (8) duplex receptacles, communication and/or audio/video services.
f. Removable and relocatable dividers to permit custom configuration of compartments as well as permit feed to adjacent compartments.
g. The compartments shall be removable from the top of the floor box with two (2) cable guides to organize and maintain the cables egress out of the box.
h. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment.
i. The box shall be able to accept 2-3/4" x 4-1/2" standard size wall plates. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles, data connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

3. Manufacturers
   a. Wiremold EFB8S-OG Floor Box. Provide EFB610xxxxx Cover Assemblies to match floor conditions. The Architect will select the finish. Provide internal device brackets to match specified communications devices and plates. Coordinate electrical rough-in with requirements of Division 26. Provide rough-in as required to mount specified communications fill.
   b. or equal (No known equal).

B. AV Floor Box, High Capacity
   1. Plan Reference: FC6
   2. Features
      a. UL Listed
      b. Box
         1) Size at least 13.5 inches by 12 inches by 6 inches deep.
         2) Two compartments, with standard electrical plate mounting brackets.
         3) The back boxes contain two identical angled mounting brackets and either side can be configured up to six gangs per side.
      c. Knockouts of 2 inch and concentric combination of 1 inch, 1.25 and 1.5 inch.
      d. At least 11 gage steel.
      e. Within cover, provide a lift-off, full-access door, open area approximately 6.5 inches by 8 inches.
      f. Within the lift-off, full-access door, provide a hinged, fold-back cable exit port.
      g. Open area of cable pass-through approximately 2 inches by 2 inches.
      h. Flush in closed position.
   3. Approvals:
      a. UL listed.
   4. Manufacturers

a. FSR Inc.FL-600P-xxx-6. Cover assemblies to match floor conditions. The Architect will select the finish. Provide manufacturer's "Pour Pan" FL-GRD2 or FL-GRD4 to protect from moisture at installations at grade level. Coordinate electrical rough-in with requirements of Division 26. Provide rough-in as required to mount specified communications fill.
b. Or equal (No known equal).

A. On Grade Floor Box, Furniture Feed

1. Drawing Reference: FF1

2. Features

a. UL Listed

b. Box
1) Stamped steel approved for use in above grade and on-grade floor applications.
2) Boxes shall have the ability to accept a component (FP-CTR) that will allow the box to be installed in polished concrete or terrazzo floors.
3) Boxes shall be painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and be approved for use on-grade and above grade floors.
4) Dimensions: 7-1/16 in. L x 6-5/8 in. W x 4-1/8 in. H
5) Provide boxes with provisions that enable installation into concrete floors, raised floors, or wood floors without having to purchase additional components or accessories.
6) Provide boxes with two (2) independent wiring compartments that allow for power, communication and/or audio/video services. Each of the two (2) wiring compartments shall have a minimum wiring capacity of 64-1/2-in3.
7) The box shall be equipped with a metal divider to separate the services and maintain code requirements.
8) The box shall contain the following number of knockouts: four (4) ½ in. trade size, four (4) 3/4 in. trade size, one (1) 1 in. trade size, six (6) 1-1/4 in. trade size, one (1) 1-1/2 in. trade size, and two (2) 2 in. trade size.
9) Boxes shall be fully adjustable, accommodating a maximum 2 in. pre-concrete pour and a maximum 1/2 in. post-concrete pour adjustment.

c. Cover
1) Manufactured of die-cast aluminum or die-cast zinc, and available in brushed aluminum finish and powder-coated paint finishes (black, gray, bronze, nickel and brass). Activation covers shall be available in flanged version. Covers shall come equipped with one (1) 1-inch trade size screw plug opening and one (1) combination 1-1/4-inch and 2-inch trade size screw plug.
2) Flanged covers shall be 7-3/4 in. L x 6-9/16 in. W.
3) Powder coat finish, color comes in black, gray, brass, nickel and bronze. Finish to be selected by the Architect.

3. Manufacturers

   a. Wiremold EFBFF-OG with Floor Port FPFFTC Series Covers. Finish to be selected by the Architect.

   b. or equal (No known equal).

B. Poke-Thru Assembly, Furniture Feed

1. Drawing Reference: FP1

2. Features

   a. UL Listed

   b. Poke-Thru Assembly

      1) Consists of an insert and activation cover. Overall poke-thru assembly length shall be 16-15/16.
      2) Insert: Insert body shall have the necessary channels to provide complete separation of power and communication services. There shall be one (1) 3/4-inch trade size channel for power and one (1) 1-1/2-inch trade size channel for communication cabling.
      3) The body will consist of an intumescent fire stop material to maintain the fire rating of the floor slab. The intumescent material will be held securely in place in the insert body and shall not have to be adjusted to maintain the fire rating of the unit and the floor slab. Insert shall have a spring-steel retaining ring that will hold the poke-thru device in the floor slab without additional fasteners. The poke-thru insert shall also consist of one (1) 3/4-inch trade size conduit stub and one 1-1/2-inch trade size conduit stub that are connected to the insert body. There shall also be a 24.5 cu in stamped steel junction box for wire splices and connections. The stamped steel junction box shall also contain the necessary means to electrically ground the poke-thru assembly.
      4) Activation Cover: The activation cover shall provide two (2) conduit openings to feed modular furniture applications and provide a flush appearance. The activation cover trim flange shall be one-piece and be manufactured of die-cast aluminum alloy and be capable of being powder coated or plated. Coated finish is to be textured, two-stage epoxy paint in gray, black, brass, nickel, bronze. Activation cover trim flange shall also be available in brushed aluminum finish. Aluminum finish shall be a brushed finish with a lacquer sealant. The activation cover shall be 8-1/4 inches in diameter. A gasket is attached to the underside of the trim flange assembly to maintain scrub water tightness by preventing water, dirt, and dust from entering the power and communication compartments.
      5) The activation cover insert shall provide one (1) 3/4-inch NPSM threaded opening for power and one (1) 1-1/2-inch NPSM threaded opening for communication to feed modular furniture workstations. Each activation cover shall also be supplied with one (1) 3/4-inch trade size and one (1) 1-1/2-inch trade size threaded conduit connectors and one (1) 3/4-inch trade size and one (1) 1-1/2-inch trade size conduit closure plugs.

3. Manufacturers

   a. Wiremold 4FFATC15 Furniture Feed Poke-Thru Assembly. Finish to be selected by the Architect.

   b. or equal (No known equal).

C. Recessed Poke-thru, 6”

1. Drawing Reference: FP6

2. Construction

   a. FP6 Poke-Thru Assembly: Poke-thru device assemblies shall consist of an insert and an activation cover. Assembly length: 16-3/4 inches (425mm). Insert body shall recess the devices a minimum of 2-3/4 inches (69mm) and have a polyester based backing enamel finished interior; ivory color. Furnish with necessary channels to provide complete separation of power and communication services. Provide five (3) compartments that allow for up to five (3) duplex receptacles that can be wired as a standard receptacle or isolated ground and/or 12 communication ports and/or 10 Legrand AVIP AV devices or 10 Extron® Electronics MAAP™ and/or two (2) AAP™ devices.
   b. Body consists of an intumescent firestop material to maintain fire rating of the floor slab. Hold intumescent material securely in place in insert body. Intumescent material will not have to be adjusted to maintain fire rating of the unit and the floor slab. Provide insert with a retaining feature to hold the poke-thru device in the floor slab without additional fasteners. Poke-thru insert shall also consist of a 3/4-inch trade size conduit stub that is connected to the insert body and a 24.5 cu in (402ml) stamped steel junction box for wire splicing and connections. Stamped steel junction box shall also contain the means necessary to electrically ground the poke-thru device to the system ground.
   c. FP6 Activation Cover: Manufactured of die-cast aluminum alloy; finished in powder-coated [gray] [black] [brass] [nickel] [bronze], finish selected by Architect. Provide with two (2) gaskets (one (1) for carpet and one (1) for tile) to go under the trim flange to maintain scrub water tightness. Activation cover is 7-1/4 inches (184mm) in diameter. Provide cover with spring-loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.
   d. Communication Modules Mounting Accessories: Provide activation unit with three locations to mount communication connectors. Mount connectors using a mounting bracket capable of accepting up to 12 Ortonics® TracJack™ Category 6 insert modules or TechChoice™ Category 6 discrete keystone connectors. Also provide unit with two (2) Category 6 discrete keystone connectors and two (2) industry standard keystones and accommodate a mechanism to permit protection of communication cabling. Fabricate mechanism from stamped steel construction. Mechanism shall accept both flexible and rigid 3/4-inch, 1-1/4-inch or two-inch trade size conduit.

3. Manufacturers

a. FP6 - Wiremold Evolution 6AT series poke-thru and cover assemblies to match floor conditions. Finish as selected by Architect. Provide internal device brackets to match specified communications devices and plates. Coordinate electrical rough-in with requirements of Division 26. Provide rough-in as required to mount specified communications fill.
b. Or equal (No known equal).

2.7 THROUGH PENETRATION SEALANT ASSEMBLY, AUTOMATIC FILL ADJUSTMENT

A. Through Penetration Sealant Assembly, Automatic Fill Adjustment

1. Drawing Reference: TPS 2 in. x 2 in., TPS 3 in. x 3 in., TPS 4 in. x 4 in.

2. Functions

a. Where indicated, cables passing through fire-rated floors or walls shall pass through fire-rated assemblies which contain an intumescent insert material that adjusts automatically to cable additions or subtractions.

b. Assemblies shall have an F Rating equal to the rating of the barrier in which the device is installed.

c. Assemblies shall be capable of allowing a 0 to 100-percent visual fill of cables.

d. Assemblies to be provided with steel wall plates allowing for single or multiple devices to be ganged together.

3. Acceptable Manufacturers:

a. Specified Technologies Inc. (STI) EZ-Path Fire Rated Pathway
1) TPS 2 in. x 2 in.
a) EZD22 Series 22 Full Kit
2) TPS 3 in. x 3 in.
a) EZDP33FWS Series 33 Full Kit
3) TPS 4 in. x 4 in.
a) EZDP44S Series 44+ Full Kit

b. Or equal.

PART 3 - EXECUTION

3.1 CONDUIT APPLICATION

A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:

1. Exterior, Exposed:

a. Type RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4 in. diameter.

b. EMT acceptable in all other applications not noted above up to 4 in., where used in conjunction with specified Raintight (compression) couplers.

2. Interior, Exposed, Wet and Damp Locations:
   a. Type RSC.
   b. At interior locations over 8 feet above finished floor, EMT acceptable.
3. Interior, Hazardous Locations
   a. Type RSC
   b. Type IMC, where permitted by the CEC.
4. Interior, exposed or concealed, dry locations:
   a. RSC, if subject to physical abuse.
   b. EMT, if not subject to physical abuse.
5. Interior, concealed, damp locations, including in masonry walls.
   a. RSC
6. Embedded in Concrete
   a. RSC or rigid non-metallic conduit.
   b. PVC Type DB-120.
7. Transition from walls to open plan furniture systems:
   a. Liquidtight

3.2 GENERAL REQUIREMENTS

A. Refer to the manufacturer's instructions and conform thereto.

B. Distribution Pathway via EMT Raceway:

1. EMT conduit is to be installed meeting the NEC handbook Article 348 Installation Specifications.
2. Provide escutcheon plates for all through wall conduit stubs.
3. All ends of conduits shall be cut square, reamed and fitted with insulated bushing.
4. All conduit which passes through fire walls shall be sealed with fire stop putty after all station wire has been installed.

3.3 MOUNTING AND INSTALLATION – DEVICE BOXES

A. Conform to the more restrictive of NEMA OS 3-2002 and the following.

B. Provide backboxes at all communications systems devices. Installation of device plates directly to wall surface without use of a backbox, unless specifically directed on plans, is unacceptable.

C. The distance between pull boxes shall not exceed 150 feet or more than two 90 degree bends.

D. Align boxes plumb with floor and surrounding construction. At door frames, locate 4 in. from frame. Verify placement with Architect details to ensure that box clears all trim, etc.

E. Support and fasten boxes securely. At stud walls use rigid bar hangers, attached to hanger with stud and nut.

F. At existing locations, provide cutting, patching and finishing as required to maintain or restore finishes so that resulting installation is integrated into the Architectural decor of the particular location.

G. Mounting Height: the mounting height of a wall-mounted outlet box is defined as the height from the finished floor to the horizontal center line of the cover plate.

H. Mount outlet boxes with the long axis vertical. Three or more gang boxes shall be mounted with the long axis horizontal.

I. Install wiring jacks and outlet devices only in boxes which are clean; free from excess building materials, dirt, and debris.

J. Install wiring jacks and outlet devices after wiring work is complete.

3.4 TERMINAL CABINETS, JUNCTION BOXES AND PULL BOXES

A. General

1. Thoroughly examine site conditions for acceptance of cabinets and enclosures installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

B. Set cabinets and enclosures plumb and symmetrical with building lines. Furnish and install all construction channel bolts, angles, etc. required to mount all equipment furnished under this Section of the Specifications.

C. Cabinets and enclosures shall be anchored and braced to withstand seismic forces calculated in accordance with standards referenced in Section 27 05 29.

D. "Train" interior wiring, bundle and clamp using specified plastic wire wraps. Separate power and signal wiring.

E. Replace doors or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.

F. Terminate conduit in cabinet with lock nut and grounding bushing.

G. Cleaning

1. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

2. Vacuum clean cabinet on completion of installation.

3.5 SUPPORT

A. Provide supports for raceways as specified in Section 27 05 29 – Hangers and Supports for Communications Systems.

B. All raceways installed in exposed dry locations shall be grouped in a like arrangement and supported by means of conduit straps, wall brackets or trapeze hangers in accordance with Code and the requirements of the this Section and Section 27 05 29 – Hangers and Supports for Communications Systems. Fasten all hangers from the building structural system.

C. Provide supports and mounting attachments per the most restrictive of Code and the following.

Raceway Size (inches)	No of cables in run	Location	Support Spacing (feet)	
			RSC	EMT
Horizontal Runs				
1≥	1-2	Flat ceiling or wall	6	6
1≥	1-2	Where access limited to building structure	10	10
1≥	3≥	Any locations	10	10
Any	Any	Concealed	10	10
Vertical Runs				
1, 1-1/4	Any	Exposed	8	8
1-1/2≥	Any	Exposed	10	10

D. Install no more than one coupling or device between supports.

E. Conduit support

1. As specified in Section 27 05 29 – Hangers and Supports for Communications Systems

F. The Architect reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the Owner.

3.6 PENETRATIONS

A. Gypsum Wall Board Penetrations: Provide circular penetrations maximum 1/8 in. inch larger than outer diameter of conduit being used. On both sides of the wall fill space between conduit and wall with joint compound, depth to match gypsum board thickness.

B. Install UL listed fire-stop system whenever a raceway penetrates a firewall in conformance with the manufacturer's directions, the published systems assembly requirements, CBC Section 709 and 710 and CEC 300-21, whichever is the most restrictive. At cable tray penetrations, provide pillow type removable fire stop per CBC Section 709 and 710, the published systems assembly requirements and the manufacturer's directions, whichever is the most restrictive.

C. All communications systems conduit openings in walls and floors are the responsibility of the Contractor. Install sleeves shown on the drawings when the concrete is poured. Any openings required after the concrete has set maybe core drilled.

3.7 RACEWAY INSTALLATION, GENERAL

A. Raceway runs are shown schematically. Install concealed unless specifically shown otherwise. Supports, pull boxes, junction boxes and similar generally not indicated. Provide where designated.

1. Install exposed conduit and raceway parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours. Level and square conduit and raceway runs.

2. Raceway runs shall be mechanically and electrically continuous between all each equipment rack and utility demarcation point, receptacle and/or surface raceway strip, as applies.

3. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box, or outlet by means of a locknut on the outside and a bushing on the inside or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter.

4. Bends

a. All bends or elbows shall have a minimum radius as follows:

Conduit Size	Min. Radius (Inches)
1-1/4 in.	18
2 in.	24
2-1/2 in.	24
3 in.	30
3-1/2 in.	30
4 in.	30
5 in.	36
6 in.	42

b. Use factory elbows or machine bends for conduit bends 1-1/4 in. and larger.

5. Make bends and offsets so the inside diameter is not effectively reduced. Make bends in parallel or banked runs from the same center line so that the bends are parallel.

6. Install at least one (1) 3/8 in., 200 pound strength nylon pull cord in all empty raceways.

7. Raceways crossing building expansion joints or in straight runs exceeding 100 feet shall be provided with UL listed expansion fittings.

8. Install conduit seals and drains to prevent accumulated moisture in conduits from entering Communications System enclosures.

B. Do not install conduit in concrete slabs unless specifically directed by Architect. Embedded conduits in concrete slab walls, and columns shall be installed in center third between upper and lower layers of reinforcing steel as directed by the Architect. Space conduits 8 in. on center except at cabinet locations where slab thickness shall be increased as directed by the Architect.

C. All conduits to be kept 12 in. away from steam or hot water lines. Install horizontal conduit and raceway runs below water and steam piping.

D. Conduit dropping down to equipment shall be as straight as possible without any offsets, parallel or perpendicular to walls, ceilings and other building features.

E. Conduit installed on any equipment shall be run symmetrical with the equipment and in such a manner as to:

1. not to be exposed to damage;

2. not interfere with access to components of the equipment that will interfere with maintenance operation or;

3. not to be in a manner that the Owner deems detrimental to its operation.

F. Whenever an installation such as that listed occurs, the Contractor shall make all necessary changes at no additional cost to the Owner.

G. All cut ends of conduit, scratches, tool marks, etc. on any metallic raceway installed in the ground or on the exterior of the building shall be treated with two coats of specified Touch Up Paint/Tape.

H. Exposed conduit and metallic surface raceway installed in finished spaces shall be painted to match surrounding surfaces using paint and methods directed by the Architect.

I. All raceways stubbing up into equipment or racks shall be sealed. Raceways with conductors shall be plugged with duct-seal. Spare raceways shall be capped. Prevent foreign matter from entering conduit and raceway; use temporary closure protection. Replace conduits containing concrete, varnish or other foreign material.

J. Complete installation of conduit and raceway runs before starting installation of cables/wires within conduit and raceway.

K. Use specified conduit and raceway fittings that are of types compatible with the associated conduit and raceway and suitable for the use and location. Join and

terminate conduit and raceway with fittings designed and approved for the purpose of the conduit and raceway system and make up tight.

L. Where chase nipples are used, align the raceway and coupling square to the box and tighten the chase nipple so no threads are exposed.

M. Horizontal conduit or EMT runs, where required and permitted, shall be installed as close to ceiling or ceiling beams as practical. Coordinate routing with the Architect.

N. Conduit and EMT connected to wall outlets shall be run in such a manner that they will not cross water, steam or waste pipes or radiator branches.

O. Conduit and EMT shall not be run through beams, purlins or columns except where permission is granted by Architect in writing.

P. Bond installed metallic raceway in accordance with the requirements of the CEC.

Q. Provide insulated bushing at the end of each conduit to prevent cable abrasion during installation.

3.8 REUSE OF EXISTING CONDUIT

A. Existing conduit is to be used as a pathway only where so shown on the drawings.

B. Prior to beginning work involving the use of an existing conduit, the Contractor shall consult with the Architect in order to establish whether or not the conduit contains active service.

C. If no active service exists within the conduit, all cable is to be removed, and work is to proceed.

D. If active service does exist within the conduit and it has been determined that service needs to be disrupted, then work on that conduit shall not proceed until a schedule of service outage has been established by the University's Representative. Once given permission to proceed, the Contractor shall within the time period of one (1) working day; remove the old cable, install, terminate and test the new cables, and notify the University's Representative of the work using the specific conduit has been completed. The Contractor shall be responsible for the disconnection and reconnecting of the active service cross-connects within the terminal closet(s).

E. Conduit preparation procedure:

1. Remove existing Wires and Cables (if any).

2. Run a mandrel ½ in. smaller than the inside diameter of the conduit through the conduit receiving new wires and cables.

3. If the specified size mandrel will not pass through the existing conduit, start with a smaller size mandrel and increase mandrel size until the specified sized mandrel will pass.

4. Run a wire brush and clean rag with an outside diameter 1/8 in. larger than the inside of the conduit through the conduit receiving new wires and cables.

5. Repeat above until conduit is clean and materials detrimental to the wire and cables to be installed no longer exit conduit with the clean rag.

3.9 STATION CABLE PATHWAY INSTALLATION

A. Station Outlet Boxes:

1. Unless otherwise noted on the plans, all cut in boxes and surface station outlet boxes are to be installed at a height of 18 in. A.F.F.(above finished floor) to center, except for those intended to be used for telephone wall jacks. Those plates or boxes that are to be used for telephone wall jacks shall be installed at a height of 54 in. A.F.F to center.

2. All station outlets shall be installed so that their edges are parallel to the vertical and horizontal edges of the surface on which they are mounted.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Cable Trays for Communications Cabling

1. Cable Trays
2. Cable Runways

B. Cable Tray Support

1.2 RELATED WORK UNDER OTHER SECTIONS

A. Section 27 05 00 – Common Work Results for Communications

B. Section 27 05 26 – Grounding and Bonding for Communications Systems

C. Section 27 05 29 – Hangers and Supports for Communications Systems

D. Section 27 05 33 – Conduits and Backboxes for Communications Systems

E. Section 27 05 53 – Identification for Communications Systems

F. Section 27 10 00 – Structured Cabling, Basic Materials and Methods

G. Section 27 13 00 – Communications Interior Backbone Cabling

H. Section 27 15 00 – Communications Horizontal Cabling

1.3 REFERENCES

A. Usage: In accordance with Section 01 11 00 – Summary of Work.

1. National Electrical Manufacturers Association (NEMA)
   a. NEMA FG 1 1-1998 Fiberglass Cable Tray Systems
   b. NEMA VE 1 1-1998 Metal Cable Tray Systems.
   c. NEMA VE 2 2001 Metal Cable Tray Installation Guidelines

1.4 SUBMITTALS

A. Conform with the requirements of Section 01 30 00 – Administrative Requirements and Section 27 05 00 Common Work Results for Communications.

1.5 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 01 60 00 – Product Requirements.

PART 2 - PRODUCTS

2.1 CABLE TRAY AND CABLE RUNWAY

A. Cable Runway (To be installed in BDF and IDF Rooms)

1. Drawing and spec reference: CR*, where "*" denotes nominal width of cable runway in inches.
2. Construction:
   a. Solid Steel Side Bar per ASTM A-36 or Tubular Steel Side Bar per ASTM A-513.
   b. 1.5" x 0.375 minimum tubular side stringers.
   c. UL Classified splice kits.
   d. Designed to support at least 100 pounds per foot load with a Safe Working Load deflection of ½" or less.
3. Finish: Telco gray powder coat or gold on zinc plating.
4. Approvals:
   a. ASTM A513
   b. UL Classified as an equipment grounding conductor.
   c. California Electrical Code, Article 318
5. Manufacturers:
   a. B-Line Telecom-Saunders SB-17.
   b. Chatsworth Products Inc. 11275 series.
   c. PW Industries
   d. or equal

B. Basket Cable Tray, Open Wire

1. Drawing and spec reference(s): CTW xx-y , where xx denotes the tray width and y the depth of the tray, in inches.
2. Construction
   a. Welded wire mesh with continuous safety edge wire lip.
   b. Mesh forms grid at nominally 2" by 4"
   c. Carbon Steel
   d. Electroplated zinc galvanized
   e. All bends, seams and joints field fabricated from basic straight section pieces and splice components as supplied by the manufacturer.
   f. Provide a complete system of accessories, including bonding and grounding connections, conduit connectors, to terminate conduits extended

to basket edge, radius shields to protect cabling at inside corners, and waterfall drop-outs at each end of cabling racks and cabinets indicated on the plans scheduled or indicated to terminate open wiring systems.

g. Provides pathway complying with ANSI/TIA-569C and NEMA Publications VE1 & VE2

h. Meets requirements of National Electrical Code, Article 318

3. Approvals:

a. NEMA Publications VE1 & VE2

4. Manufacturers:

a. B-Line Wire Basket Runway

b. Cablofil

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Provide all required supports, fittings and accessories for a complete system as described in NEMA VE-2, by Code, manufacturer recommendation or as shown on the plans, whichever is most restrictive.

B. Bond sections to one another and to building ground.

C. Access Clearance. Maintain access for use by City's personnel to tray as described below. Coordinate installation with work of structural, mechanical, plumbing/fire protection and electrical trades to maintain required access.

1. Unless shown otherwise on the plans, provide a clear access of at least 24" wide along one side of each tray for use by City's personnel.

2. Unless shown otherwise on the plans, installation to maintain at least 12" vertical clearance over the top of each tray for use by City's personnel.

3.2 SUPPORT

A. Support in accordance with the most restrictive of the following:

1. Contractor’s engineered means of engineered support submitted in accordance with the requirements of 27 05 00 – Common Work Results for Communications and Section 27 05 29 – Hangers and Supports for Communications Systems.

2. California Building Code, including but not limited to requirements of Volume 2, Chapter 16, Division IV, Section 1632 and Table 16-O.

3. Metallic Cable Tray: NEMA VE 2-2001, or latest edition

4. Fiberglass Cable Tray: NEMA FG-1-1998, or latest edition.

B. Provide lateral sway bracing as required by Code.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all labor, materials, transportation and equipment to complete the furnishing, installation, assembly, and set up of the Communications System Raceway, Conduit and Backbone work indicated on the drawings and specified herein. Notwithstanding any detailed information in this Section, provide complete, contiguous working raceway systems.

B. Communications Outside Plant Ductwork - refer to the drawings for demarcation of the work of this Project.

1. Communications Outside Plant Ductwork.
2. Communications Manholes
3. Communications Pullboxes
4. Connection of underground ductbanks to campus buildings

1.2 RELATED WORK IN OTHER SECTIONS:

A. Section 31 23 17 – Trenching, Backfilling, and Compacting

B. Section 27 05 00 – Common Work Results for Communications Systems.

C. Section 27 05 26 – Grounding and Bonding for Communications Systems

D. Section 27 05 33 – Communications, Raceways, Boxes and Fittings

1.3 REGULATORY REQUIREMENTS

A. In addition to requirements of Division 1, comply with the following.

1. Public Utilities Commission of the State of California.
   a. Rules for Overhead Electric line Construction, General Order No. 95 inclusive of all Decisions or Resolutions thereto authorized with Date Effective up to and including 30 days prior to the bid opening day.
   b. Rules for Underground Electric Line Construction, General Order No. 128 inclusive of all Decisions or Resolutions thereto authorized with Date Effective up to and including 30 days prior to the bid opening day.

1.4 REFERENCES

A. Usage: In accordance with Division 1.

B. BICSI

1. 2004 Customer Owned Outside Plant Design Manual

C. American National Standards Institute (ANSI)

1. ANSI C80.1 1990 Rigid Steel Conduit - Zinc Coated

D. State of California, Business, Transportation and Housing Agency, Department of Transportation (CalTrans)

1. Standard Specifications, July, 1999, or latest edition.

2. Standard Plans, July 1999 or latest edition.

E. National Electrical Manufacturers Association (NEMA)

a. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)

b. ANSI/NEMA FB 1-2003 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

c. FB 2.10 2000 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).

d. FB 2.20 2000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable

e. NEMA FG 1 1-1998 Fiberglass Cable Tray Systems

f. NEMA ICS 6 2001 Industrial Controls and Systems Enclosures

g. NEMA RN 1 1998 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

h. NEMA TC 2 2003 Electrical Polyvinyl Chloride (PVC) Conduit

i. NEMA TC 3 1999 PVC Fittings for Use with Rigid PVC Conduit and Tubing

j. NEMA TC 6&8 2003 PVC Plastic Utilities Duct for Underground Installations

k. NEMA TC 7 2000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct

l. NEMA TC 9 1999 Fittings for ABS and PVC Plastic Utilities Duct for Underground Application

m. NEMA TC 14 1984(R 1997) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings

n. NEMA TC 19 2001 Nonmetallic Riser U-Type Guards

o. NEMA VE 1 1-1998 Metallic Cable Tray Systems.

p. NEMA VE 2 2001 Cable Tray Installation Guidelines

2. Underwriters Laboratories, Inc. (UL)

a. UL 6 2004 Electrical Rigid Metal Conduit - Steel

b. UL 360 1986 (R 2003) Liquid-Tight Flexible Steel Conduit

c. UL 514A 1991 (R 2004) Metallic Outlet Boxes

d. UL 514B 1989 (R 2004) Conduit, Tubing, and Cable Fittings

e. UL 514C 1988 (R 1996) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.

f. UL 651 1989 (R 1995) Schedule 40 and 80 Rigid PVC Conduit.

1.5 SUBMITTALS

A. Conform with the requirements of Division 1 and Section 27 05 00 Common Work Results for Communications.

1.6 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Division 1.

1.7 SEQUENCING

A. Not Used.

PART 2 - PRODUCTS

2.1 DUCTBANK CONSTRUCTION

A. PVC Conduit

1. Drawing and Spec Reference: PVC.

2. Construction:

a. 4" trade diameter, unless otherwise noted.

b. Poly-vinyl chloride.

c. Schedule by Application
   1) Straight segments, Schedule 40.
   2) Flat elbows, Schedule 40.
   3) Vertical elbows sweep up to grade, Schedule 80.
   4) Above grade, Schedule 80.

d. Elbows.
   1) Where innerduct liner is scheduled – CRSC.
   2) Elsewhere, Schedule 80.
   3) 90° C rated.
   4) Solvent welded joints, joints by pipe manufacturer.

e. Application.
   1) Soil Backfill/Direct Burial
      a) RUS Type II, Type C or Type DB
      b) Schedule 40.
   2) Concrete Encasement:
      a) PVC Type DB-120,

b) RUS Type I, Type B or Type EB
c) Any meeting Soil Backfill/Direct Burial.

3) Boring
a) HDPE.
b) RUS Type Flexible Plastic.

f. Performance:
1) Tensile Strength: 7,000 psi at 73.4° F.
2) Flexural Strength: 11,000 psi.
3) Compressive Strength: 8,600 psi.

g. Approvals:
1) RUS Listed for Telephone Cable Installation 5-99 Edition, or latest release thereof.
2) NEMA TC-2, PVC Type EPC-40 and EPC-80.
3) NEMA TC-3.
4) NEMA TC14 Fiberglass Conduit.
5) UL 514 fittings.
6) UL 651.
7) ANSI C33.91.

h. Manufacturers:
1) RUS Listed:

Manufacturer	RUS Listed for	Manufacturer Part Number
Allwire, Inc.	Flexible plastic	ALLDUCT
American Pipe & Plastics	Plastic	Type B, C, and D
	Plastic	Type EB and DB
	Plastic	PVC Multi-Duct (2,3,4 and 6-way)
Americon International	Flexible plastic	HDPE Duct
	Plastic	PVC Type C
Apache Plastics, Inc.	Plastic	Type EB and Type DB
ARMCO	Plastic	Smooth-Cor Type B and Type C
Arnco	Flexible plastic	HDPE Conduit
Bay Plastics, Inc.	Plastic	Type B and Type C
Bristolpipe	Plastic	Type B, C, and D
	Plastic	Type EB and Type DB
Can-Tex	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
Carlon	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
	Plastic	Multi-Gard
Certain-Teed Products Corp.	Plastic	Type EB and Type DB
CIBA-GEIGY	Fiberglass	T & D Conduit
Condux International, Inc.	Concrete	Condux
	Plastic	Type EB and Type DB
CSR Polypipe	Flexible plastic	HDPE Duct
Dura-line	Flexible plastic	HDPE Duct

Eagle Pacific Industries, Inc.	Plastic	Type EB and Type DB
	Flexible plastic	HDPE Coiled Duct
Endot Industries	Flexible plastic	HDPE Duct
Freedom Plastics, Inc.	Plastic	Type C
Hercules, Inc.	Flexible plastic	Corflo plastic conduit
Hurlbut Plastic Pipe	Plastic	Type C
Ingomar Plastic Pipe	Plastic	Type B and Type C
J-M Manufacturing Company	Plastic	Types C, EB, and DB
Kyova	Plastic	Type EB and Type DB
SCP National Plastics, Inc.	Plastic	Type EB and Type DB
	Plastic	Type B and Type C
Northern Pipe Products	Plastic	Type B, C, and D
OMNI	Flexible plastic	HDPE Duct
Petroflex	Flexible plastic	HDPE Duct
	Flexible plastic	Corrugated HDPE Duct
Phillips Products Co., Inc.	Flexible plastic	Driscon 3200
Phone Ducs	Plastic	Multiple plastic conduit (4, 6, & 9 Way)
PLEXCO	Flexible plastic	PLEXCO Duct
PWPipe	Plastic	Type EB and Type DB
Pyramid Industries, Inc.	Plastic	Type EB and Type DM
	Flexible plastic	HDPE Conduit
Quail Plastics	Plastic	Type EB and Type DB
Queen City Plastics	Plastic	Type EB and Type DB
River City Plastics	Plastic	Type EB and Type DB
Sedco	Plastic	Type EB and Type DB
Southern Pipe, Inc.	Plastic	PVC Types EB, DB, and Sch. 40
Tamaqua Cable Products	Flexible plastic	HDPE Duct
Tridyn Industries	Plastic	Type EB and Type DB
Vassallo Industries	Plastic	Type B and Type C
Wesflex	Flexible plastic	Flex-Con

2) or equal

2.2 FITTINGS

A. Couplings, adaptors, transition fittings, etc., shall be molded PVC, slip on, solvent weld type conforming to NEMA TC3 for Schedule 40 or 80 and NEMA TC 9 for type EB or DB.

B. Fitting Types

1. Expansion Fittings, 12”, Metallic:

2. Function: At road or bridge expansion joints requiring up to 12” of expansion compensation.

3. Approvals:

a. CalTrans

4. Construction
   a. Steel, hot dip galvanized.
   b. Nylon wear bushings
   c. O-ring seal
   d. Bonding jumper
5. Manufacturers:
   a. O-Z Gedney Type AX, Type AX-8, and Type EX fittings with Type BJ Bonding Jumper.
   b. TVC/Vikimatic VB0285X series.
   c. Or Equal.

C. Expansion Fittings, 6”, Non-metallic:
1. Function: At road or bridge expansion joints requiring up to 6” of expansion compensation.
2. Construction
   a. Fiberglass
   b. Provide bonding jumper.
3. Manufacturers:
   a. TVC Communications HW or Extra Heavy Wall Expansion Joint.
   b. Vikimatic
   c. FRE Composites, Inc.
   d. Or Equal.

D. Caps, Underground Conduit Stubs
1. Provide at each location indicated for future expansion.
2. Wateright.
3. Manufacturers:
   a. Carlon E985N
   b. Vikimatic

E. Refer to Section 27 05 33 – Communications, Raceways, Boxes and Fittings for additional fittings.

2.3 UNDERGROUND STRUCTURES

A. Vaults, PullBoxes and Manholes, Precast, General

1. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes, boxes and handholes.

2. Construction

   a. General
      1) Castings shall be free from warp and blow holes that may impair strength or appearance.
      2) Structures shall be precast to the design and details indicated, precast monolithically and placed as a unit, or structures may be assembled in sections, designed and produced by the manufacturer in accordance with the requirements specified.
      3) Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.
      4) Structure top and wall shall be of a uniform thickness of not less than 4 inches except at knockouts.
      5) The minimum concrete cover for reinforcing steel shall be 2 inches.
      6) All steel, except reinforcing steel, shall be hot dip galvanized after fabrication.
      7) Knockouts & Windows
         a) Thin-walled knock-out panels designed for future duct bank entrances are permitted.
         b) Sides of precast windows shall be a minimum of 4 inches from the inside surface of adjacent walls, floors, or ceilings.
         c) Form of the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope.
         d) Provide welded wire-fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes.
         e) Provide additional reinforcing steel comprised of at least 2 No. 4 bars around window openings.
      8) Extension Rings
         a) Provide extension rings as-required to extend from finished grade to communications utilities.
      9) Bottom and Drain Sumps
         a) Provide solid concrete bottom surface.
         b) Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.

3. Joints:

   a. Provide tongue-and-groove or shiplap joints on mating edges of precast components.

   b. Design joints to firmly interlock adjoining components and to provide waterproof junctions, and adequate shear transfer.

   c. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B.

4. Frames and Covers

a. Covers to match across all utilities.

b. Provide fiber composite lids at pedestrian rated covers, H-20 steel slip resistant covers otherwise.

c. Labeling
   1) Provide labeling as follows:
      a) "Communications"
      b) Owner's Manhole or Vault No, as shown on drawings or provided to Contractor prior to vault order placement.
   2) Labeling shall be:
      a) Cast in concrete lids
      b) Written in weld on steel lids
      c) Alternatively, for pedestrian grade vault lids and for the vault number only, provide 1/8" min. thickness lamacoid label, rivet attached to box top in recess area below surface of lid.

5. Pulling-In-Irons

   a. Steel bars bent in the form indicated and cast in the walls and floors.

   b. Install a pulling-in iron in the wall opposite each duct line entrance at walls, not less than 6 inches above or below, and opposite the conduits entering the manhole.

   c. Pulling-in irons shall project into the manhole approximately 4 inches, or be cast in a pocket. Iron shall be hot-dipped galvanized after fabrication.

   d. Provide cable racks, including rack arms, minimum two (2) 12" arms each manhole or vault face.

B. Underground Pull Boxes and Vaults, Concrete

1. Drawing and Specification References:

   a. PB1P

   b. PB1T

   c. PB2P

   d. PB2T

   e. PB3T

2. Minimum Size

   a. As scheduled on the drawings. Provide scheduled or larger size.

3. Lid Construction:

   a. As scheduled on the plans

4. Cover Components

   a. PB1 and PB2 Size: One piece construction

   b. PB3 Size: Two piece hinged lids with torsion spring lifters.

5. Pulling-In-Irons

a. Steel bars bent in the form indicated and cast in the walls and floors.

b. Install a pulling-in iron in the wall opposite each duct line entrance at walls, not less than 6 inches above or below, and opposite the conduits entering the manhole.

c. Pulling-in irons shall project into the manhole approximately 4 inches, or be cast in a pocket. Iron shall be hot-dipped galvanized after fabrication.

6. Provide cable racks, including rack arms, minimum two (2) 12" arms each vault face.

7. Manufacturers:

a. Brooks Products
   1) 1P & 1T: 5 Series and extension rings as required
   2) 2P & 2T: 67 Series and extension rings as required
   3) 3T: 400 Series with 11C Type Lid.

b. Jensen PreCast
   1) PB1P: P9 with FL9D lid, P9BA base and extension rings as required.
   2) PB1T P9 with P9-61 lid, P9BA base and extension rings as required
   3) PB2P: P36 with FL36D cover, P36BA base and extension rings as required
   4) PB2T: P36 with P36-61D lid, P36BA base and extension rings as required
   5) PB3T: 35TA

c. Utility Vault Company, Inc./Oldcastle Precast
   1) PB3T: PTS-3660, with H-20-44 loading cover, with 3660-06 and 3660-12 extensions as required.

d. Associated Concrete Products

e. Forni Corporation.

f. Or equal.

C. Manhole/Maintenance Hole

1. Drawing and Specification Reference:

a. MH: Maintenance Hole, 4 feet 6 inches by 8 feet 6 inches inside.

2. Construction:

a. SBC Reference Specification PTS-65 for overall size and shape.
   1) Arrange duct bank entry per latest BICSI outside plant manual, not SBC standard
   2) Provide non-metallic racking and cable support arms, not SBC standard metallic arms.
   3) Increase wall thickness where indicated installation depth exceeds rating of PTS-65 assembly.

b. Ladder
   1) Provide 1 ladder per maintenance hold

2) Steel, hooks to rungs at top of maintenance hold neck, long enough to reach bottom of maintenance hole.

3. Manufacturers

a. Utility Vault Company, Inc. 38-PTS-65, with cover with nameplate "Communications", with 3606 and 3612 extensions as required, with ladder.

b. Jensen PreCast PTS-65

c. Associated Concrete Products

d. Forni Corporation.

e. Or equal.

2.4 MISCELLANEOUS UNDERGROUND PRODUCTS

A. Cable Warning Tape

1. Provide

a. 6 inches wide minimum.

b. 5 mil plastic.

c. Metallic backing at least 10 feet o.c.

d. 1 mil metallic foil core.

e. Orange in color

f. Suitable for buried applications.

g. Continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" or similar at not more than 48 inch intervals.

2. Manufacturers:

a. Carlon Telecom Systems.

b. Vikimatic

c. Or equal.

B. Pull Rope

1. At least 3/4 inch diameter polyethylene or polyester.

2. 2500 pound strength.

3. Manufacturers:

a. Carlon Telecom Systems.

b. Vikimatic

c. Or equal.

C. Length Marked Tape

1. Provide 1/2 inch flat tape with sequential markings in whole feet.
2. Manufacturers:
    a. Carlon Telecom Systems.
    b. Greenlee
    c. Vikimatic
    d. Or equal.

D. Conduit Plugs

1. Provide universal blank duct plug type, with eye for tying rope and tape.
2. Manufacturers:
    a. Carlon Telecom Systems.
    b. Condux International, Inc.
    c. Or equal.

E. Line Marker Post

1. Orange polyethylene, post height 4 feet above surface.
2. Soil anchor.
3. Manufacturers:
    a. Carlon Telecom Systems.
    b. Vikimatic
    c. Or equal.

F. Conduit Spacer, Trench

1. Construction
    a. Non-metallic.
    b. Sized to snap around conduits as shown on Drawings.
    c. Interlocking.
2. Manufacturers:
    a. Underground Devices Wunpeece.
    b. GS Industries Underground Products Spacer System.
    c. Or equal.

G. Pulling In Irons

1. 7/8" Diameter
    a. 6" exposed length minimum after imbedment
    b. RUS approved

2. Manufacturer
    a. Cooper Power Systems
    b. Or equal.

H. Cable Racks & Supports

1. Construction:
    a. Non-metallic
    b. 12" minimum rack arms
    c. Snap into vertical strut sections provided with new manhole, pullboxes and vaults, or into Owner's existing vaults, where indicated.

2. Approvals
    a. RUS
    b. NEMA

3. Manufacturers:
    a. Underground Devices
    b. Inwesco
    c. Cooper Power Systems
    d. Or Equal

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Refer to the most restrictive of the Code, the manufacturer's instructions, these specifications and the relevant NEMA, CalTrans or RUS guidelines and conform.

3.2 CONDUIT APPLICATION

A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:

1. Underground Ductbanks, Concrete Encased
    a. PVC

B. Exterior, Exposed:

1. Type RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.

2. EMT acceptable in all other applications not noted above up to 4", where used in conjunction with specified Raintight (compression) couplers.

C. Embedded in Concrete

1. RSC or rigid non-metallic conduit.
2. PVC

D. In Utility Tunnel

1. RSC
2. CRSC
3. IMC

3.3 RACEWAY INSTALLATION, GENERAL

A. Refer to Section 27 05 33 – Conduits and Backboxes for Communications Systems

3.4 UNDERGROUND CONSTRUCTION:

A. Duct and Conduit Placement.

1. Duct lines shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet.
2. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.
3. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.

B. Duct Bank.

1. Duct Entrance Arrangement - Conform to Table 3.27 and applicable arrangement diagrams 3.57-3.64 of 2004 BISCI Customer Owned Outside Plant Design Manual.
2. Terminate conduits in end-bells where duct lines enter underground structures.
3. Stagger conduit joints by rows and layers to strengthen the duct bank.
4. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of duct bank. Before pouring concrete or backfilling, as applies, anchor duct bank assemblies to prevent the assemblies from floating. Anchoring shall be

done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.

5. As each section of a duct line is completed from structure to structure, for conduit sizes 3 inches and larger draw a flexible testing mandrel approximately 12 inches long with a diameter less than the diameter of the conduit through a conduit. After which, draw a stiff bristle brush having the same diameter of the conduit through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs.

6. Unless otherwise noted, exterior communications conduit runs shall be buried a minimum of **30"** below finished grade or as required to conform to local utility requirements. Where new trenching is required, backfill and compaction requirements shall be as defined in other Sections.

7. Where concrete encasement indicated, construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than shown. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from communications conduits by a minimum concrete thickness of 4 inches. The top of the concrete encasement shall not be less than 18 inches below grade except that under roads and pavement concrete be a minimum of 24 inches below grade.

C. Where conduit runs under existing roads, cut and patch the pavement as indicated.

D. Conduit Plugs and Pull Rope. New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a 3/8 inch nylon pull rope having 3 feet of slack at each end of unused or empty conduits.

E. Partially Completed Duct Banks. During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 1 foot apart. Restrain reinforcing assembly from moving during concrete pouring.

F. Connections to Existing Manholes. For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and bend out to tie into the reinforcing of the duct line encasement. Chip out the structure wall to form a key for the duct line encasement.

G. Mark locations of future provision underground raceways by pre-cast reinforced concrete pullbox set flush in ground with stamped brass disk identification plate tied to conduit end with “Ty-Wrap”, “Quick-Wrap” or equal.

H. In existing facilities underground construction, the Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be brought to the immediate attention of the Owner’s Representative. If the Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the Owner’s Representative of any such damage.

I. At twelve inches below grade, place specified warning tape continuously.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provisions of:

1. Flexible communications raceway connections to vibrating machinery
2. Sealing of communications device boxes related installed in sound rated walls.
3. Coordination of airtight installation requirements at Mechanical and Electrical Rooms and/or duct enclosures.

PART 2 - PRODUCTS

2.1 FLEXIBLE COMMUNICATIONS CONNECTIONS:

A. Make communications connections to vibrating equipment flexible as follows:

1. For conduit over 1 in. O.D. make communications connections to vibrating equipment via a flexible expansion/deflection conduit coupling sized as required. Coupling shall have flexible and watertight outer jacket, internal grounding strap, plastic inner sleeve to maintain smooth wireway, and end hubs with threads to fit standard threaded metal conduit.
2. Manufacturers:
   a. XD Xpansion Deflection Coupling by Crouse-Hinds of Syracuse, N.Y.
   b. Type DF Expansion and Deflection fitting by Spring City Electrical Mfg. Co.
   c. or equal.

2.2 J-BOX MASTIC:

A. At all electrical boxes penetrating sound isolating partitions, STC 40 or greater, utilize sheet form adhesive mastic as directed elsewhere herein

B. Manufacturers:

1. Insul-Pad by Dottie Corp.
2. Duct-Seal by Gardner Bender, Inc.
3. or equal.

2.3 RESILIENT PENETRATIONS:

A. For conduit:

1. Sleeves: Sleeves of appropriate gage galvanized sheet metal shall be formed to at least the thickness of the penetrated construction and 3/4 in. to 1 in. larger in each cross-sectional dimension than the penetrating element.

    a. Manufacturers:
        1) Century-Line Sleeves by Thunderline Corporation
        2) Custom by Contractor
        3) or equal.

2. Batt: Glass fiber of batt or mineral wool, 1 to 3 lb./cu. ft. density.

    a. Manufacturers
        1) Certain-Teed
        2) Johns-Manville
        3) or equal.

3. Acoustical Sealant:

    a. Manufacturers
        1) DAP
        2) Pecora
        3) or equal.

4. Firestop Sealant:

    a. Where required, resilient firestop caulking may be used in lieu of Acoustical Sealant when installed in strict conformance with the manufacturer's directions. Fully hardened firestop caulk shall develop a Shore A hardness of no greater than 35. Refer to the requirements of Section 27 05 33.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS, CONNECTION TO VIBRATING EQUIPMENT

A. The Contractor shall not install any vibrating equipment or conduit attached thereto which makes rigid contact with the "building" unless it is approved in this specification or by the Owner's Representative. "Building" includes, but is not limited to slabs, beams, columns, walls, partitions, ceilings, studs, ceiling framing and suspension systems.

B. Prior to installation, the Contractor shall bring to the Owner' Representative's attention any conflicts between trades which will result in unavoidable rigid contact at equipment, conduit, piping, ducts, etc., as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

3.2 INSPECTION OF CONDITIONS:

A. Examine related Work and surfaces before starting Work of this Section. Report to the Owner's Representative, in writing, conditions which will prevent proper provision of this work. Beginning the Work of this Section without reporting unsuitable conditions to

the Architect constitutes acceptance of such conditions by Contractor. Perform any required removal, repair, or replacement of this Work caused by unsuitable conditions at no additional cost to the Owner.

B. Coordination

1. Coordinate with the work of the Base Building Construction Contract. Coordinate Work of this Section with all other impacted trades.

3.3 INSTALLATION REQUIREMENTS, FLEXIBLE ELECTRICAL CONNECTIONS

A. The installation of flexible electrical connections to vibration isolated equipment shall in no way impair or restrain the function of the vibration isolation installed by the work by Others.

1. Using gross slack. Install flexible conduit in a grossly slack loop form or shallow "U" form. Install stranded conductors with sufficient slack to accommodate maximum possible movement.

2. Using flexible coupling. The flexible coupling shall be free and not in contact with any nearby building construction and shall be installed slack, and free of strain in any direction. Install stranded conductors as above

3.4 INSTALLATION REQUIREMENTS, J-BOX MASTIC

A. Application: All Communications Systems work in sound isolating assemblies, including but not limited to residential rooms, offices, mechanical rooms, electrical rooms and related to utilize backboxes for all services, including but not limited to low voltage communication. Installation of backboxes to conform with following:

1. Space outlet boxes on opposite faces of the wall by more than 24 in. o.c. Where daisy chainned conduits indicated on the plans, connect such boxes by slack flexible conduit (2 times longer than distance between outlets).

2. Cutouts for electrical boxes and penetrating piping/conduit shall be no more than 1/4 in. oversize.

3.5 INSTALLATION REQUIREMENTS, RESILIENT PENETRATIONS

A. Penetrations included in this Section of the Specifications include all communications conduit connected to vibrating equipment within 30 feet of such equipment

B. Method for round or rectangular penetrations.

1. Cut a clean opening in the penetrated construction very nearly the size of the sleeve for each penetrating element. Provide lintels above, relief structure below and vertical framing between and to the sides, as required. Provide the above, escutcheon plates and such related construction as is necessary to make the penetrated structure as solid and massive near the penetrations as the surrounding construction.

2. Set the metal sleeve into the penetrated construction in an airtight manner around its outer periphery, using grout, dry packing, plaster or drywall compound

full depth and all around - but only to a maximum width of ½ in. - or the requirements of the above paragraph shall not have been satisfied.

3.6 MECHANICAL AND ELECTRICAL ROOMS REQUIREMENTS

A. All mechanical and electrical rooms, plenums, duct shafts and drywall duct enclosures and other enclosures of high noise sources shall be constructed airtight. This means that every precaution shall be taken to maintain construction completely airtight around a room so designated. Construction joints, duct penetrations, electrical boxes, frames, supports, cabinets, doors, access panels, fixtures, etc., all shall be built or installed in such a manner as to prevent sound transmission through any construction enclosing a room horizontally or vertically. Appropriate lintels, frames, blocking, escutcheons, grouting, gaskets, packing, caulking, taping, filling, etc., all shall be employed to prevent sound transmission. Refer to requirements of this Section for Resilient Penetrations.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

A. Provide all labor, materials, tools, and equipment required for permanent intelligible labeling on, or adjacent to, all cabling, connectors, innerduct, faceplates, jacks, receptacles, controls, fuses, circuit breakers, patching jacks, and racks.

B. This section includes minimum requirements for the following:

1. Labeling Communications Cabling
2. Labeling Closet Hardware
3. Labeling Work Stations
4. Labeling Pathways, Spaces, Grounding and Bonding.

C. Refer to detailed plans for additional requirements.

D. Clearly and distinctly indicate the function of the item.

E. Coordinate with Record Drawings

1.2 REFERENCES:

A. Usage:

1. American Society for Testing and Materials (ASTM)
   a. ASTM D 709(2001) Laminated Thermosetting Materials
2. Electronic Industries Alliance (EIA)
   a. EIA TIA/EIA-606-A(2002) Administration Standard for Commercial Telecommunications Infrastructure (ANSI/TIA/EIA-606)
3. Underwriters Laboratories (UL)
   a. UL 969 (1995; R 2001) Marking and Labeling Systems

1.3 QUALITY ASSURANCE

A. Identification and administration work specified herein shall comply with the applicable requirements of:

1. ANSI/TIA/EIA – 606-A Administration Standards.
2. ANSI/TIA/EIA – 569B Pathway and Spaces
3. ANSI/TIA/EIA – 568B Telecommunications Cabling Standard.
4. BICSI Telecommunications Distribution Methods Manual.

5. UL 969 (1995; R 2001) Marking and Labeling Systems.

PART 2 - PRODUCTS

2.1 COMMUNICATION CABLING LABELS, INTERIOR

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

C. Provide vinyl substrate with a white printing area and black print. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.

D. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.

E. Shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing.

F. Manufacturers:

1. Cable Type – Silver Satin
    a. Brady TLS2200 labels – PTL-31-427, PTL-32-427
    b. Brady Laser tab labels – LAT-18-361, LAT-53-361
    c. Hubbell
    d. Leviton
    e. Panduit.
    f. or equal.
2. Cable Type – 4 pair UTP
    a. Brady TLS2200 labels – PTL-31-427,PTL-32-427
    b. Brady Laser tab labels – LAT-18-361, LAT-53-361
    c. Hubbell
    d. Leviton
    e. Panduit.
    f. or equal.
3. Cable Type – 4 pair STP
    a. Brady TLS2200 labels – PTL-21-427
    b. Brady Laser tab labels – LAT-19-361
    c. Hubbell
    d. Leviton

e. Panduit.

f. or equal.

4. Cable Type – 25 pair copper
   a. Brady TLS2200 labels – PTL-21-427
   b. Brady Laser tab labels – LAT-19-361
   c. Panduit.
   d. or equal.
5. Cable Type – 50 pair copper
   a. Brady TLS2200 labels – PTL-33-427
   b. Panduit.
   c. or equal.
6. Cable Type – 100 pair copper
   a. Brady TLS2200 labels – PTL-34-427
   b. Brady
   c. Panduit.
   d. or equal.
7. Cable Type – 2 strand fiber
   a. Brady TLS2200 labels – PTL-19-427
   b. Brady Laser tab labels– LAT-17-361
   c. Panduit.
   d. or equal.
8. Cable Type – 4-12 strand fiber
   a. Brady TLS2200 labels – PTL-21-427
   b. Brady Laser tab labels – LAT-19-361
   c. Panduit.
   d. or equal.
9. Cable Type – RG-6 Coax
   a. Brady TLS2200 labels – PTL-31-427, PTL-32-427
   b. Brady Laser tab labels –LAT-18-361, LAT-53-361
   c. Panduit.
   d. or equal.
10. Cable Type – RG-59 Coax
    a. Brady TLS2200 labels – PTL-31-427, PTL-32-427

b. Brady Laser tab labels – LAT-18-361, LAT-53-361

c. Panduit.

d. or equal.

11. Cable Bundles

a. Brady TLS2200 labels – PTL-12-109

b. Panduit.

c. or equal.

2.2 COMMUNICATIONS CABLE LABELS, OUTSIDE PLANT

A. Cable Tags in Manholes, Handholes, and Vaults

1. Provide tags for communications cable or wire located in manholes, handholes, and vaults.

a. The tags shall be polyethylene.

b. Machine printed - Do not provide handwritten letters.

2. Polyethylene Cable Tags

a. Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F.

b. Provide 0.05 inch (minimum) thick black polyethylene tag holder.

c. Provide a one-piece nylon, self-locking tie at each end of the cable tag.

d. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background.

e. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

3. Manufacturers:

a. Panduit

b. Brady

c. or equal.

2.3 CLOSET HARDWARE LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

C. Where insert type labels are used provide clear plastic cover over label.

D. Manufacturer:

1. Copper Patch Panels
    a. 4 port group
        1) Brady Laser tab labels – 2.8 in. x 0.375 in. LAT-43-707
        2) Hubbell XPLPPA series
        3) Leviton
        4) Panduit.
        5) or equal.
    b. 6 port group
        1) Brady Laser tab labels – 3.6 in. x 0.375 in., LAT-44-707
        2) Hubbell
        3) Leviton
        4) Panduit.
        5) or equal.
    c. Individual port
        1) Brady
            a) TLS2200 labels – 0.5 in. x 0.375 in.white, PTL-44-422
            b) Laser tab labels – 0.5 in. x 0.375 in. white, LAT-45-707
            c) TLS2200 labels – 0.5 in. x 0.375 in.clear, PTL-44-430
            d) Laser tab labels – 0.5 in. x 0.375 in. clear, LAT-45-712
            e) TLS2200 labels – 0.5 in. x 0.5 in. white, PTL-7-422
            f) Laser tab labels – 0.5 in. x 0.5 in. white, LAT-46-707
            g) TLS2200 labels – 0.5 in. x 0.5 in. clear, PTL-7-430
            h) Laser tab labels – 0.5 in. x 0.5 in. clear, LAT-46-712
        2) Hubbell
        3) Leviton
        4) Panduit.
        5) or equal
    d. Patch Panel Name Label.
        1) Hubbell XOLPPID Series
        2) Brady
        3) Leviton
        4) Panduit
        5) or equal.
2. Non-keystone based fiber patch panels
    a. Hubbell XPLFOSEPAW
    b. Brady
    c. Leviton
    d. Panduit
    e. as provided with Patch Panel by the manufacturer
    f. or equal.
3. 110 blocks

a. Brady Laser tab labels – 7.9 in. x 0.475 in. (200.6mm x 12.07mm), LAT-177-124

b. Hubbell XPL110 series.

c. Leviton

d. Panduit.

e. or equal.

2.4 GROUNDING AND BONDING, PATHWAY, AND SPACE LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

C. Manufacturers:

1. Brady Corporation

a. TLS2200 labels
1) PTL-20-422, Size 2.0 in. x 1.0 in.
2) PTL-22-422, Size 3.0 in. x 1.0 in.
3) PTL-37-422, Size 3.0 in. x 1.9 in.
4) PTL-23-422, Size 4.0 in. x 1.0 in.
5) PTL-38-422, Size 4.0 in. x 1.0 in.

b. Laser tab labels
1) LAT-13-747, Size 1.875 in. x 0.833 in.
2) LAT-24-747, Size 1.75 in. x 1.0 in.
3) LAT-32-747, Size 3.0 in. x 0.9 in.
4) LAT-33-747, Size 2.0 in. x 1.437 in.
5) LAT-34-747, Size 3.0 in. x 1.437 in.

c. Continuous tape for TLS2200
1) PTL-8-422, Size 0.5 in. white polyester
2) PTL-8-430, Size 0.5 in. clear polyester
3) PTL-8-439, Size 0.5 in. white vinyl
4) PTL-42-439, Size 1.0 in. white vinyl
5) PTL-43-439, Size 1.9 in. white vinyl

2. Panduit.

3. or equal.

2.5 WORKSTATION LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

C. Where insert type labels are used provide clear plastic cover over label.

D. Manufacturers:

1. Brady Corporation
    a. Desi-strip inserts
        1) TLS2200 labels –1.9 in.x0.375 in. white, PLT-40-412
        2) Laser tab labels –1.9 in.x0.375 in. white, LAT-176-124
    b. Location ID
        1) TLS2200 labels - 1.0 in. x 0.375 in. white, PTL-16-422
        2) Laser tab labels –1.0 in. x 0.375 in. white, LAT-47-707
        3) TLS2200 labels- 1.0 in. x 0.375 in. clear, PTL-16-430
        4) Laser tab labels –1.0 in. x 0.375 in. clear, LAT-8-712
        5) TLS2200 labels- 1.0 in. x 0.5 in. white, PTL-17-422
        6) Laser tab labels –1.0 in. x 0.5 in. white, LAT-7-707
        7) TLS2200 labels- 1.0 in. x 0.5 in. clear, PTL-17-430
        8) Laser tab labels- 1.0 in. x 0.5 in. clear, LAT-7-712
        9) TLS2200 labels- 1.5 in. x 0.375 in. white, PTL-45-422
        10) Laser tab labels- 1.5 in. x 0.375 in. white, LAT-47-707
        11) TLS2200 labels- 1.5 in. x 0.375 in. clear, PTL-45-430
        12) Laser tab labels-1.5 in. x 0.375 in. clear, LAT-47-712
        13) TLS2200 labels- 1.5 in. x 0.5 in. white, PTL-29-422
        14) Laser tab labels- 1.5 in. x 0.5 in. white, LAT-47-707
        15) TLS2200 labels- 1.5 in. x 0.5 in. clear, PTL-29-430
        16) Laser tab labels-1.5 in. x 0.5 in. clear, LAT-47-712
    c. Outlet/Jack ID
        1) TLS2200 labels -0.5 in. x 0.375 in. white, PTL-44-422
        2) Laser tab labels – 0.5 in. x 0.375 in. white, LAT-45-707
        3) TLS2200 labels - 0.5 in. x 0.375 in. clear, PTL-44-430
        4) Laser tab labels –0.5 in. x 0.375 in. clear, LAT-45-712
        5) TLS2200 labels - 0.5 in. x 0.5 in. white, PTL-7-422
        6) Laser tab labels- 0.5 in. x 0.5 in. white, LAT-46-707
        7) TLS2200 labels - 0.5 in. x 0.5 in. clear, PTL-7-430
        8) Laser tab labels - 0.5 in. x 0.5 in. clear, LAT-46-712
    d. General Use Labels
        1) TLS2200 labels - 0.375 in. cont. white, PTL-46-422
        2) TLS2200 labels - 0.375 in. cont. clear, PTL-46-430
2. Hubbell
    a. Location ID
        1) Desi-Strip Style
            a) XPLFP10W
        2) Adhesive
            a) XPLFPA10W, XPLFPA10W,
    b. Outlet/Jack ID
        1) XPLIPA10W, XPLIPA10C
3. Leviton
4. Panduit.

5. or equal.

2.6 NAMEPLATE

A. Field Fabricated Nameplates

1. Features/Function/Construction

a. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.

b. Comply with ASTM D 709.

c. Each nameplate inscription shall identify the function and, when applicable, the position.

d. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core.

e. Surface shall be matte finish.

f. Corners shall be square.

g. Accurately align lettering and engrave into the core.

h. Minimum size of nameplates shall be one by 2.5 inches.

i. Lettering shall be a minimum of 0.25 inch high normal block style

PART 3 - EXECUTION

3.1 GENERAL

A. Apply labeling to clean surfaces free of oil, dust, solvents or loose material.

B. Apply after Project painting in area of application is complete.

C. Apply to locations where labeling will not be damaged, covered over or in the way of the ordinary maintenance and operation of the installed communications infrastructure or system.

D. Apply labeling right side up, parallel to major edges of surfaces to which it is applied. When no line is evident, apply parallel to floor line. Correct conditions of labeling applied out of true.

E. Protect installed labeling from damage.

F. Replace labeling that is defaced, illegible or peeling off of the surface to which it is applied.

3.2 WORKSTATION JACK, CABLE AND PATCH PANEL ASSIGNED CIRCUIT NUMBERS

A. The Owner's representative will provide the Contractor copies of the Contract Drawings showing station outlets with Owner assigned data & voice jack ID numbers. Label all installed work according to this master set.

B. The cover plate area directly above and beneath the jacks are the labeling areas. In the top area, using the specified means, label the faceplate number assigned on the contract documents.

3.3 IDENTIFICATION & LABELING

A. Pathways

1. Pathways shall be marked at each endpoint and at all intermediate pull or junction boxes. In the case of partitioned pathways (i.e. innerduct) each partition shall have a unique identifier.

2. Label pathways using the appropriate abbreviation and a number.

3. Use adhesive type labels.

B. Labels shall be affixed at the entry to all telecommunications rooms and spaces (Includes entrance facilities, communication equipment rooms, communication equipment spaces and work areas)

1. Use adhesive type labels for all communications space labeling,

2. Affix labels to entrance doors – coordinate location with Owner's Representative.

C. Cables

1. Horizontal and Indoor Backbone Cables shall be marked within 12 in. of each endpoint or to innerduct in which the cable is installed.

2. Except where installed in innerduct or conduit, all backbone fiber optic cable shall have affixed to the outer jacket, labels of a bright color that contain at least the legend "FIBER OPTIC CABLE." These labels must be affixed at separations no greater than 10 ft.

3. Within every manhole/vault/pullbox and within 4 ft of the entrance into a building every backbone cable’s assigned identifier shall be affixed to either the cable’s outer jacket or to innerduct in which the cable is installed.

4. Any cable installed in conduit shall be labeled at all intermediate pull or junction boxes.

5. Label cables using the appropriate circuit ID.

6. Use adhesive type labels for all communications cable labels.

7. Affix labels to cables – marking cable is not permitted.

8. Where cable is fully encased in innerduct label the outside of the innerduct with the cable label and, where the contents are fiber optic cabling, the "FIBER OPTIC CABLE" label.

9. Horizontal Cables:

    a. Example: “BDF1.1- 107-01-D1-CAT6AE”
        1) First field: the originating MDF/ BDF/IDF room identity; for example: “AD1.1”.
        2) Second field: the destination room number; for example: “107”.
        3) Third field: a unique sequential outlet number; for example: “01” (1st outlet in the room).
        4) Fourth field: a unique port number; for example: “D1” (“D” for data service, 1st port of the outlet).

D. Patch Panels

1. Fiber patch panels shall be marked using adhesive labels indicating the range of circuits installed to it. All fiber optic cable patch panels shall be labeled with both the pair count of every fiber pair, the cable’s assigned identifier, and where shown on the plans, the patch panel's assigned identifier.

2. Category rated patch panels shall be labeled with an identifier, individual ports shall be labeled to indicate circuit and identification of station plate in which the circuit terminates.

    a. Example: “107-D1”
        1) First field: the end user room number; for example: “107”.
        2) Second field: outlet port number; for example: “D1” (“D” for data service, 1st port of the outlet)

E. 110 blocks

1. Each cable termination position on 110 blocks shall be labeled with number designators.

    a. All backbone copper cable termination blocks shall be labeled with both the pair count of every 5th pair and the cable’s assigned identifier.

2. Where insert type labels are used install clear plastic cover over reprinted or Laser printed type label.

F. Workstations

1. All faceplate labels shall indicate the faceplate number and the circuit ID for each cable that it houses

    a. Example: “BDF1.1-107-01”
        1) First field: The originating MDF/BDF/IDF room identity; for example: “BDF1.1”.
        2) Second field: the destination room number; for example: “107”.
        3) Third field: a unique sequential outlet number; for example: “01” (1st outlet in the room).

2. Individual ports at the outlets:
    a. Example: “D1” (data service, 1st port of the outlet)
        1) First field: the cable’s intended service type followed by a unique sequential number.
3. For faceplates where insert type labels are used install clear plastic cover over preprinted or Laser printed type label.
4. For faceplates without insert type labels use adhesive type labels affix labels to faceplate – marking faceplates is not permitted.
5. Patch cords cords installed under the work of this Project shall be labeled at each endpoint using the appropriate circuit ID.
6. Use adhesive type labels for all communications cable labels.
7. Affix labels to cables – marking cable is not permitted.

G. Wireless AP label:
1. Example: “107-AP1-9AFF”
    a. First field: the end user room number; for example: “107”
    b. Second field: Wireless AP number AP1, AP2, etc.
    c. Third filed: last 4 digit of the AP Ethernet port MAC address.

H. Grounding and Bonding
1. The TMGB(s) (telecommunications main ground bar) shall be labeled as such with an adhesive type label(s) affix label(s) to TMGB.
2. The conductor connecting the TMGB (telecommunications main ground bar) to the building ground shall be labeled at each end with an affixed label in a visible location as close as practicable to the bonding point at each end of the conductor.

I. Firestopping
1. Each firestopping location shall be labeled at each location where firestopping is installed, on each side of the penetrated fire barrier, within 12 in. of the firestopping material.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED WORK IN OTHER DIVISION 27 SECTIONS

A. Section 27 05 00 – Common Work Results for Communications applies to the work of this Section.

1.3 SUMMARY

A. This section specifies common standards, means and methods for the work of the following Sections:

1. Section 27 11 19 – Communications Termination Blocks and Patch Panels
2. Section 27 11 23 – Communications Cable Management
3. Section 27 15 00 – Communications Horizontal Cabling

1.4 REFERENCES

A. Usage: In accordance with Division 1.

B. In Addition to the requirements of Section 27 05 00 – Common Work Results for Communications, conform to the applicable portions of the following standards agencies:

1. National Fire Protection Association (NFPA)
   a. NFPA 70 National Electrical Code
2. Telecommunications Industry Association (ANSI/TIA)
   a. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
   b. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, 2009
   c. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard, published 2009
   d. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard, published 2008, including errata issued in October, 2008.
   e. ANSI/TIA 569-C (2012) Telecommunications Pathways and Spaces
   f. ANSI/TIA-606-B (2012) Administration Standard Telecommunications Infrastructure

g. ANSI- J-STD-607-B (2011) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

1.5 SUBMITTALS

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 27 05 00 Common Work Results for Communications.

1.6 QUALITY ASSURANCE

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 27 05 00 Common Work Results for Communications.

1.7 DELIVERY, STORAGE AND HANDLING

B. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and the following:

A. Shipping Conditions:

1. All cable shall be shipped on reels or manufacturer supplied “handy boxes”.
2. The diameter of the drum shall be at least 13 times the diameter of the cable.
3. The reels shall be substantial and so constructed as to prevent damage during shipment and handling.
4. Secure the outer end of the cable to the reel head so as to prevent the cable from becoming loose in transit.
5. Project the inner end of the cable into a slot in the side of the reel, or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.
6. The inner end shall be fastened so as to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable.

B. Storage:

1. Do not roll or store cable reels without an appropriate underlay.
2. Retain factory cable protection until installation. Supplement with heavy gauge plastic sheeting if factory protective membrane is pierced prior to installation. Tape ends and seams water and dust tight.
3. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent.
4. Protect cable reels from physical damage from site construction vehicles or from settling into the soil.

5. Equipment, other than outside plant rated cable protected with fully watertight cable caps, to be delivered and placed in storage, suitably protected from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

C. Handling

1. Cabling other than outside plant cabling exposed to standing water or other liquids at any time during storage, delivery or placement shall be replaced at no expense to the Owner.

2. Cut ends of outside plant rated cabling or portions of outside plant rated cable with a damaged jacket shall not be exposed to standing water or other liquids at any time during storage, delivery or placement. Where such conditions occur, the Owner's representative may require that the cable be replaced at no cost to the Owner.

1.8 WARRANTY

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 27 05 00 Common Work Results for Communications.

1.9 PERFORMANCE STANDARDS

A. Horizontal (Station) Category 6A Copper Cabling – Permanent Link

1. Testing shall commence while the Owner's equipment in the area of service is operational and creating worst case emissions associated with its operation while in good working order. Every effort shall be made to include worst case influence on the materials install shall be taken.

2. In accordance with the field test specifications defined in ANSI/TIA-568-C.2 "*Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard*", every horizontal station cabling link in the project shall be tested for:

a. Wire Map

b. Length

c. Insertion Loss

d. NEXT Loss

e. PS NEXT Loss

f. ACR-F Loss

g. PS ACR-F Loss

h. Return Loss

i. Propagation Delay

j. Delay Skew

3. Using the listed Category 6A cable test set, test installed cabling using Permanent Link procedure and submit report demonstrating that the link meets the following parameters:

Frequency (MHz)	Insertion Loss (dB/100m)	NEXT (dB)	PSNEXT (dB)	ACRF (dB)	PSANEXT (dB)	Return Loss
1.0	2.10	74.3	72.3	67.8	67.0	20.0
4.0	3.8	65.3	63.3	55.8	67.0	23.0
10.0	5.9	59.3	57.3	47.8	67.0	25.0
16.0	7.5	56.2	54.2	43.7	67.0	25.0
20.0	8.4	54.8	52.8	41.8	67.0	25.0
31.3	10.5	51.9	49.9	37.9	67.0	23.6
62.5	15.0	47.4	45.4	31.9	65.6	21.5
100.0	19.10	44.3	42.3	27.8	62.5	20.10
250.0	31.10	38.3	36.3	19.8	56.5	17.30
350.0	37.20	36.1	34.1	16.9	--	16.30

   a. Each permanent link shall demonstrate a positive PSACR beyond 350 MHz to meet and exceed the bandwidth requirements of TIA-568-C.2 Category 6A standards. Each permanent link shall demonstrate 2 dB of cross talk headroom over TIA-568-C.2 Category 6A standard for NEXT, PSNEXT, ACRF and PSANEXT bit error rate.

4. Report whether tested link passes or fails

5. Note exceptions to required Category standards. Remedy and retest

1.10 CATEGORY 6A STATION CABLING PERFORMANCE TESTING

A. General Requirements

1. In accordance with the field test specifications defined in ANSI/TIA-568-C.2 "*Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard*" (TIA Cat 6A Standard), every cabling link in the installation shall be tested for:

   a. Wire Map

   b. Length

   c. Insertion Loss

   d. NEXT Loss

   e. PS NEXT Loss

   f. ACR-F Loss

   g. PS ACR-F Loss

h. Return Loss

i. Propagation Delay

j. Delay Skew

2. In addition to testing the “In-link” performance parameters specified above, Alien Crosstalk testing or “Between-link” testing shall be carried out in accordance with Section 4.7 of ANSI/TIA-1152. Alien crosstalk testing includes the PS ANEXT and PS AACR-F (Power sum alien attenuation-to-crosstalk ratio from the far end) performance parameters. The standards refer to the link-under-test for Alien Crosstalk as the *disturbed* link.

3. PS ANEXT and PS AACR-F shall meet or exceed the limits defined in Section 6 of the TIA Cat 6A Standard.

   a. Selection of disturbed links: 1 % of the links in the cabling installation or 5 links, whichever is more. Chose short, medium and long links equally.

   b. Selection of disturber links. Select all of the links that are in the same cable bundle and the most consistently positioned relative to the disturbed link as disturbing links.

4. If the margin of PS ANEXT and PS AACR-F exceeds 5 dB for the first three short, medium and long links (nine in total), further alien crosstalk testing can be discontinued.

5. The installed twisted-pair horizontal links shall be tested from the IDF in the telecommunications room to the telecommunication wall outlet in the work area for compliance with the “*Permanent Link*” performance specification as defined in the TIA Cat 6A Standard.

6. One hundred percent of the installed cabling links must pass the requirements of the standards mentioned in above and as further detailed below. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance Section 27 05 00.

7. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).

8. The test equipment (tester) shall comply with the accuracy requirements for Level IIIe field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy *plus* adapter contribution) are specified in Table 4 of ANSI/TIA-1152.

9. The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.

10. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

11. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.

12. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in Section 4.2.2 of ANSI/TIA-1152). Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.

13. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks. To which extent '*' results shall determine approval or disapproval of the element under test shall be defined in the relevant detail specification, or agreed on as a part of a contractual specification.

14. The Owner's Representative will select a random sample of 5% of the installed links. The representative (or his authorized delegate) shall test these randomly selected links and the results are to be stored as specified herein above. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the end-user representative shall repeat 100% testing and the cost shall be borne by the installation contractor.

B. Performance Test Parameters.

C. The test parameters for Cat 6A are defined in the TIA Cat 6A standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 500 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

1. Wire Map. Shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

2. Length. The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation (NVP). The physical length of the link shall be calculated using the pair with the shortest electrical delay. This

length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.

3. Insertion Loss (Attenuation). Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz through 500 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.

4. NEXT Loss. Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 500 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the standard as shown in Table 1. . Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

Maximum frequency step size as defined in ANSI/TIA-1152	
Frequency Range (MHz)	Maximum Step size (MHz)
1 – 31.25	0.15
31.26 – 100	0.25
100 – 250	0.50
250 – 500	1.00

5. PS NEXT Loss. Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 500 MHz and the step size may not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS NEXT.

These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

6. ACR-F, pair-to-pair. Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ACR-F Loss that must be evaluated and reported in the test results. ACR-F measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ACR-F is to be measured from 1 through 500 MHz and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the standard as in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR-F. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

7. PS ACR-F Loss. Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

8. Return Loss. Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured form 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

9. Propagation Delay. Propagation delay is the time required for the signal to travel from one of the link to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

10. Delay Skew [as defined in the TIA Cat 6A Standard; Section 6.2.19] This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results):

Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.

11. PS ANEXT. Pair-to-pair Alien NEXT (ANEXT) contributions is measured by applying the stimulus signal at the near end to one wire pair of a disturbing link and measuring the coupled signal at the near end of a wire pair in a disturbed link. This process is repeated for every wire pair in a disturbing link. The PS ANEXT for each wire pair in a disturbed link is obtained by the power sum addition of all the pair-to-pair ANEXT results to that wire pair from all wire pairs in disturbing links. All the links that are bundles with the disturbed link need to be included as disturbing links. In addition, links that are terminated in adjacent positions in a patch panel or interconnect panel should also be included as disturbing links in this test.

    a. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS ANEXT. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

12. PS AACR-F. The pair-to-pair Alien Far End crosstalk (AFEXT) contributions is measured by applying the signal at the near end to one wire pair of a disturbing channel or permanent link and measuring the coupled signal at the far end of a wire pair in a disturbed channel or permanent link. This process is repeated for every wire pair in a disturbing link and for all links in close proximity. A normalization, which is dependent on the relative length of disturbing and disturbed link, is applied to each pair-to-pair alien FEXT measurement. Then the PS Alien Attenuation-to-Crosstalk Ratio from the Far end (PS AACR-F) for each wire pair in a disturbed channel or permanent link is obtained by the power sum addition of all the normalized pair-to-pair far end alien crosstalk results to that wire pair from all wire pairs in disturbing links in close proximity.

    a. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS AACR-F. If the link or channel connects two patch panels (data center), these wire pairs must be identified for the tests performed from both ends. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

D. Test Result Documentation

1. The test results/measurements shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.

2. The database for the completed job shall be stored and delivered on CD-ROM or DVD or equivalent media selected by the Owner’s Representative, including the software tools required to view, inspect, and print any selection of test reports.

3. A PDF copy of the test results shall be provided that lists all the links that have been tested with the following summary information
    a. The identification of the link in accordance with the naming convention defined in the overall system documentation
    b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number
    c. The date and time the test results were saved in the memory of the tester.
4. General Information to be provided in the electronic data base with the test results information for each link:
    a. The identification of the customer site as specified by the end-user
    b. The identification of the link in accordance with the naming convention defined in the overall system documentation
    c. The overall Pass/Fail evaluation of the link-under-test
    d. The name of the standard selected to execute the stored test results
    e. The cable type and the value of NVP used for length calculations
    f. The date and time the test results were saved in the memory of the tester
    g. The brand name, model and serial number of the tester
    h. The identification of the tester interface
    i. The revision of the tester software and the revision of the test standards database in the tester
5. In-link (In-Channel) detailed test results. The detailed test results data to be provided in the electronic database for must contain the following information:
    a. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
    b. Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m and the test limit value
    c. Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value
    d. Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value
    e. Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair
    f. Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link

g. NEXT, ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link

h. PS NEXT and PS ACR-F: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link

6. Between-Link (Between-Channel) Test Results Data. A test report shall be provided for each disturbed link included in the Alien Crosstalk sample test. This test report must contain

a. PS ANEXT results at each frequency for each wire pair in a victim link as well as the PS ANEXT results for the average of these four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS ANEXT shall be measured and tested from the end of the link or channel where all cables are terminated at a distribution panel. In case the cabling runs from panel to panel (data center) where the worst case PS ANEXT margin is less than 2 dB, the PS ANEXT test results for each disturbed link shall be collected and saved from both ends (both panels) of the disturbed link.

b. PS AACR-F results at each frequency tested for each wire pair in a disturbed link as well as the PS AACR-F results for the average of the four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS AACR-F only needs to be measured and tested from one end of the link or channel.

E. Fiber Optic Cabling - as specified herein below.

1.11 TESTING

A. General

1. In addition to the tests detailed in this specification section, the contractor shall notify the Owner's Representative of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional measurement results at no additional charge

2. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications room wiring.

3. Test each end to end cable link.

4. Submit machine-generated documentation and raw data of all test results on Contractor-provided, and Owner's Representative approved, forms; and in electronic format approved by the Owner's Representative.

5. Provide machine-generated data on an appropriate disk media (CD-ROM CD-R format) to be transferred to the Owner's computers.

a. Where the machine-generated documentation requires use of a proprietary computer program to view the data, provide the Owner with 1 licensed copy of the software.

6. Provide registered testing software used for the actual tests to the Owner for review of test data.

B. Test Equipment:

1. Provide in conformance with the applicable requirements of 27 05 00 - Common Work Results for Communications.

2. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:

a. Level IIIe field testers as defined in ANSI/TIA-1152 - Fluke DSX, Agilent or equal.
   1) The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of ANSI/TIA-1152 (Table 4 in this TIA document also specifies the accuracy requirements for the Channel configuration).
   2) The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
   3) The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction..

b. Outside Plant Voice Cabling Plant tester - capable of detecting shorts, opens, reversals, mis-wiring and crosstwists. (Siemon STM-8, Fluke or equal).

c. Tone Test Sets.

d. Optical Power Meter (Corning Cable Systems, Fluke DSX or equal)
   1) Power measurement uncertainty of ± 0.25 dB.
   2) Store reference power measurement.
   3) Save at least 100 results in internal memory.
   4) PC interface (serial or USB).
   5) Minimum Performance - Single Mode Power Meter
      a) 1300nm and 1500nm (± 20 nm) wavelength dual laser light sources.
      b) Output power of –10 dBm minimum
      c) Output Stability +/- 0.40 dB from 0 to 50 degrees C
      d) Long Term output stability +/- 0.10dB at 25 degrees C
      e) Measurement range shall be from 10 to -60 dBm
      f) Accuracy shall be +/- 5% at 0 to -50dBm and +/- 10% 10 to 0dBm and -50 to -60 dBm.
      g) Resolution shall be 0.1 dB

h) Connector types shall include: LC, ST, SC.

e. Optical Time Domain Reflectometer. (Fluke, JDSU or equal).
1) Singlemode OTDR
a) Wavelengths of 1310 nm (± 20 nm) and 1550 nm (± 20 nm).
b) Event deadzones of 3.5 m maximum at 1310 nm and 1550 nm.
c) Attenuation deadzones of 10 m maximum at 1310 nm and 12 m maximum at 1550 nm.
d) Distance range not less than 10000 m.
e) Dynamic range at least 10 dB at 1310 nm and 1550 nm

f. Site portable communications systems (walkie-talkie, cell phone or similar).

g. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

C. Station Wiring, General

1. Test station wire only after all pairs of station wire in a work area have been terminated at both ends, and no work of this Section or other Sections may cause physical disturbance to the wiring.

2. Correct any and all transpositions found. Retest.

3. If any conductor in a station wire tests either open or short, then the entire station wire is to be removed, replaced, and re-tested.

D. Inside Category 6A Cabling.

1. Using the listed Category 6A cable test set, test and submit report on the parameters specified for Category 6A cabling in this Section. Report whether tested link passes or fails the Category 6A standards. Cables must pass TIA Permanent Link Certification for the cable type being installed. A "Marginal" test result will not be accepted.

2. Note exceptions to required Category standards. Remedy and retest.

PART 2 - PRODUCTS

2.1 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the Owner.

2.2 ACCEPTABLE MANUFACTURERS

A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.

2.3 COMMUNICATIONS CABLES AND RELATED

A. GENERAL:

1. Cabling shall be UL listed for the application and shall comply with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3 and NFPA 70.
2. Ship cable on reels and/or in boxes bearing manufacture date for UTP in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project.
3. Cabling manufactured more than 12 months prior to date of installation shall not be used.
4. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
   a. At plenums, provide type CMP or OFNP cabling.
   b. At risers, provide type CMR or OFNR cabling
   c. At horizontal wiring conditions, provide type CM or OFN cabling.
5. Refer to Section 27 14 00 - Communications Outside Plant Backbone Cabling for underground cabling installation

PART 3 - EXECUTION

3.1 GENERAL

A. All system cabling and terminations be installed in accordance with the manufacturer's instructions and as shown.

B. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.

C. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.

D. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.

E. The Contractor shall be responsible for all damage to the cable during placement.
   1. Cabling shall be maintained free of splits, holes or blisters.
   2. Cabling shall not be painted or exposed to construction solvents or other caustic chemicals unless rated and warrantied for such exposure by its manufacturer.

F. Correct unacceptable wiring conditions including but not limited to:
   1. Deformed, brittle or cracked insulation.

2. Torn or worn cable jacket.

3. Excessively scored cable jackets.

4. Insulation shrunken or stripped further than 1/8 in. away from the actual point of connection within a connector, or on a punch block.

5. Ungrommeted, unbushed, or uninsulated wire or cable entries.

6. Deformation or improper radius of wire or cable.

3.2 PULLING IN

A. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.

B. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.

C. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.

D. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.

E. Pull Rope/Tape

1. For ISP installations, pull new pull rope through all conduits while placing new backbone cable. Leave a pull rope in the utilized conduits for future use.

F. Do not leave cable slack on cable runway

G. Firestop all sleeves, station cable conduit and ISP backbone conduit openings through rated partitions after the cable installation is complete.

3.3 SUPPORT

A. Support: Provide support for all cabling. Conform to the restrictions of the California Electric Code and Section 27 05 29. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

B. Separation from sources of Electromagnetic Interference: Conform with the requirements of ANSI/TIA-569-C, 9.3 Pathway Separation from EMI sources.

3.4 CATEGORY RATED STATION PROOF OF PERFORMANCE DEMONSTRATION

A. Comply with the requirements of Part 1 of this Section and the following:

1. After submittal of test result documentation and the associated as-built drawings, the Owner's Representative shall randomly pick five percent (5%) of the submitted cable plant installation for re-test.

2. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the representative shall repeat 100% testing at no cost to the Owner.

3.5 LABELING

A. Reference Section 27 05 53 - Identification for Communications Systems, the plans and the specifications.

B. Comply with labeling instructions to include, but not be limited to, the following:

1. Label technology to be utilized;

2. Label content;

3. Label placement

3.6 REMOVAL OF ABANDONED CABLING

A. The California Electrical Code (CEC) requires all unused telecommunications cable intended for future use to be terminated in a patch panel or cross-connect and labeled for such use. Any other unused cable is considered abandoned including cable abandoned due to installation of new cabling under the work of this Project.

B. Abandoned cable must be removed and disposed of, per CEC 770.53(A) & 770.53(B) (fiber) and 800.52(B), 800.53(A) & 800.53(B) (copper). Similar requirements are elsewhere in the CEC for other types of cable.

C. Refer to Division1 regarding means and methods to be employed in the disposal of construction waste materials including material subject to recycling such as abandoned copper cabling.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Communications racks and cabinets.

B. Communications Rack Mounted Power Protection and Power Strips

1.2 RELATED WORK IN OTHER SECTIONS

A. Section 27 05 26 – Grounding and Bonding for Communications Systems

1. Bonds racks and cabinets.

B. Section 27 05 33 – Conduits and Backboxes for Communications Systems

1. Signal systems raceways at communications rooms

C. Section 27 05 36 – Cable Trays for Communications Systems

1. Signal systems cable tray at communications rooms

D. Section 27 11 26 – Communications Rack Mounted Power Protection and Power Strips

1. Installation of rack mounted power strips, protection and distribution units.

E. Section 27 13 00 – Communications Indoor Backbone Cabling

1. Inside Backbone Terminations at communications rooms.

F. Section 27 15 00 Communications Horizontal Cabling

1. Rack mounted horizontal patch panels.

1.3 REFERENCES

A. American National Standards Institute (ANSI)

1. EIA/ECA-310-E (2005) Cabinets, Racks, Panels, and Associated Equipment

2. ANSI/TIA-607-D-2019 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

B. International Conference of Building Officials (ICBO)

1. AC156 ICBO ES Acceptance Criteria for Seismic Qualification Testing of Nonstructural Components (Jul. 2004)

C. Telecordia Technologies

1. Network Equipment Building System (NEBS) GR-63-CORE (Seismic Zone 4)

1.4 SUBMITTALS

A. Conform with the requirements of Section 01 30 00 – Administrative Requirements and Section 27 05 00 - Common Work Results for Communications.

1.5 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 01 60 00 – Product Requirements and Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

PART 2 - PRODUCTS

2.1 GENERAL

A. KEYS

1. Key all boxes, cabinets, enclosures, panels, controls, doors and related provided for similar usage within a system identically.

2.2 EQUIPMENT ENCLOSURE SYSTEMS

A. General:

1. Provide enclosure systems including, but not limited to enclosures, cabinets, cases and related panels and accessories as specified herein. Provide size and quantity as shown on drawings or scheduled.

2. Provide color as shown on drawings. If no color is shown on drawings, submit manufacturer's standard color chips for selection.

3. Provide enclosure systems conforming to the CBC, latest edition, for seismic design.

4. Equipment Enclosures: Each rack provided with frame angles tapped 10-32, ANSI/EIA 310-D Universal Spaced.

B. Equipment Rack, Undercounter, Pullout and Pivoting

1. Drawing Reference: R18

2. Features/Construction:

a. EIA compliant 19 in. rotating slide-out equipment rack intended for permanent installation and integration into a millwork or cabinet opening.

b. Overall dimensions of rack shall be not more than 19.25 in. wide x 20 in. deep

c. Rack shall support up to a 300 pound loading, in closed and pull-out operation.

d. Rack shall pull out 19 in. on integrated ball bearing slides and rotate 90º for equipment servicing. When rotating rack, locking detent shall allow rack to lock in place at 0, 60 and 90 degrees of rotation.

e. Rackrail shall be 11-gauge steel with tapped 10-32 holes in universal EIA spacing. Rackrail shall be finished in black e-coat with marked rackspaces.

f. Rough-in pan shall be 14-gauge steel.

g. Finish on assembly shall be durable flat black powder coat.

h. Trim/locking panel shall lock SRSR in closed position and be 11-gauge aluminum with brushed black anodized finish.

i. Unless otherwise noted, completely enclose interior of enclosure, or ensembles of enclosures with equipment, blank or vent panels

3. Manufacturers

a. Middle Atlantic SRSR–4-14.

b. Or equal (no known equal).

C. Relay Rack, Integrated Vertical Wire Chase, Zone 4 rated

1. Drawing Reference(s)

a. R15

2. Construction

a. Capacity: 1,000 lb and meet Telecordia Technologies GR-63-CORE Network Equipment Building Systems (NEBS) Zone 4 requirements.

b. Mounting Channels: Punched on the front and rear flange with the EIA-310-D Universal hole pattern

c. Supports 19 in. EIA-310-D compliant rack-mount equipment like patch panels and

d. network switches

e. #12-24 threaded equipment mounting rails

f. Equipment mounting rails to have marked and numbered rack-mount spaces (U). Numbering start at bottom of the rack.

g. Fully bonded rack with two masked grounding locations and includes a two mounting hole. Ground Terminal Block for easy connection to the Telecommunications Grounding Busbar.

h. Overall width shall be no more than 24 in..

i. 44 EIA Rack Units minimum.

j. Provide fifty (50) 12-24 rack mounting screws per rack.

k. Separate front and rear 6 in.W x 6.38 in.D cable managers attach with included offset brackets to align with the front and rear of the rack.

3. Manufacturers, Zone 4 rated assembly - subject to minimum panel opening criteria scheduled above:

a. CPI Seismic Frame Two Post Rack 13853-703 with Seismic Frame Two-Post Vertical Cabling Section 13704-703.

b. B-Line Advantage Seismic Relay Rack SB-852-19-084 FB.

D. Drawing References: R28

1. Minimum Features, Function & Construction:

a. Manufacturer tested Zone 4 assembly, rated for at least 900 pounds of uniformly distributed load, upper floor load, of essential equipment per California Building Code/Uniform Building Code.

b. Fully welded construction provides:
   1) Static load capacity: 10,000 lbs.
   2) UL Listed load capacity: 2,500lbs.
   3) Seismic Certified load capacity: 755 lbs.

c. Seismic certified to the following codes and standards: 2007 & 2010 CBC; 2006, 2009 & 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity – Zone 4 or Seismic Design Category (SDC) "D". Intended for use in Mission Critical and/or High-Importance Installations in locations with the highest level of seismicity and top floor or rooftop installations including those within UBC and CBC Essential facilities or IBC, ASCE 7, and NFPA 5000 Seismic Use Group III facilities. For all codes, the Importance factor (Ip) is 1.5.

d. Vertical Height (Min): 44 RU

e. Outside depth: 40” minimum - 42 inches maximum.

f. Width: Not to exceed 30 inches

g. Lockable, 70% open area perforated mesh full height front and rear doors:
   1) Front door with wire mesh insert covers rack contents - swing shall be field adjustable to swing from either right or left.
   2) Rear doors to be a pair of half width doors, each with a wire mesh to cover rack contents.
   3) Wire mesh, vertical center split rear door pair.

h. Front and rear 19" mounting rail pairs DIN square holes on EIA spacing standard are fully adjustable in depth of setback from front to rear.

i. Vertical cable management rings, continuous, full height cable management system shall be installed:
   1) fully inside of the rack enclosure, with 2" minimum clearance behind front and rear rack frame.
   2) fully outside (to left of left rail and to right of right rail, and out of conflict with EIA Rails. Cable management system mounting shall not occupy rail screw openings.
   3) Front managers shall be accessible from front in fully loaded equipment rack.
   4) Rear managers shall be accessible from rear in fully loaded equipment rack

j. 60% or greater perforated top panel occupying at least 50% of the stop surface of the cabinet allows passive heat radiation from rack interior to the exterior.

k. Cutouts and removable covers in cabinet top accommodates vertical transition of cabling from tray above into rack interior.

l. Gangable. Racks have been designed such that they are suitable for installation either as a single, standalone unit, or in a row of identical racks (gangable).
   1) Single rack installation. Provide side panels at both sides.
   2) Multirack installation in a row. Bolt racks together using means provided by manufacturer. Omit side panels except at ends of row of racks – provide at ends of rows of racks.

2. Manufacturers. Provide manufacturer's accessories or 3rd party accessories as specified elsewhere in this Section for other specified elements. Coordinate selected shelves, fans and similar with rack submitted for finish and mounting means.:

   a. Middle Atlantic DRK19-44-42PRO with DLVFD-44 front door, DCLVRD-44 rear doors, MRK-Z4 Base angles, 2 pair DRK-44DUCT (front and rear, 4 total vertical ducts),MW-LVT 64% open area top insert. Keylocked side panels SPN-44-36 at ends of rows.

   b. Equal by CPI Z4-Series Seismic Frame Cabinet System

E. AV Credenza with Equipment Rackbay

1. Drawing Reference: R42, refer to keynotes on plans for locations below displays in Conference and Group Study Spaces

2. Manufacturer:

   a. Middle Atlantic C3-FF32, coordinate finish w/ Architect

   b. Or equal

2.3 RACK PANELS AND ACCESSORIES

A. Rack Mounting Screws:

1. Screws 10-24; length as required for at least 1/4 in. excess when fully seated; oval head with black plastic non marring cup washer or equivalent ornamental head; nickel, cadmium or black plated; Phillips, Allen Hex, Square-Tip or Torx drive. Slotted screws are not acceptable.

B. Vertical Lacer Strips

1. 44RU high vertical steel strips with points for attachment of velco cable ties at at least 6 in. o.c.

2. Manufacturer:

   a. CPI

C. Horizontal Lacer Bars

1. EIA 19 in. Width steel strips or bars suitable to provide support to large cable dressed horizontally through racks

2. Size to suit load and mounting width.

3. Manufacturer:

a. CPI.

PART 3 - EXECUTION

3.1 MOUNTING

A. Unless otherwise noted, all floor supported equipment racks shall be bolted to the structure in accordance with the requirements of the CBC and the contractors approved structural engineering submittal demonstrating the method to be used to conform to these requirements.

B. Rows of identical racks shall be bolted together, in addition to being bolted to the floor, and bonded to form a single electrical ground plane.

C. Wall mounted equipment racks and cabinets shall similarly be bolted to structural members in accordance with the requirements of the CBC and the contractors approved structural engineering submittal demonstrating the method to be used to conform to these requirements.

3.2 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT BACKBOARD FABRICATION

A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.

B. Provide permanent labels for all equipment and devices.

C. Floor racks to be bolted floor unless otherwise indicated.

D. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.

E. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.

F. Where wiring of mixed types are called for on the plans, maintain separation of wiring classifications as specified in the individual sections of the Communications Work. Separately dress, route and land microphone, audio line level and data cables and related on the right side of the equipment enclosure, as viewed from the rear; dress, route, and land loudspeaker level, data and control cables on the left side of the equipment enclosure, as viewed from the rear.

G. Provide vertical wire management of cabling within the rack independent of the adjustable EIA mounting rails. Vertical wiring management provided by the contractor within the rack shall not prevent such rails from being moved as required by the Owner.

H. Dress and support cabling at a minimum of 24 inch on center.

I. Access shall not require demounting or de-energizing of equipment or cabling. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.

J. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.

K. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.

3.3 SIGNAL GROUNDING & BONDING PROCEDURES

A. Comply with National Electrical Code and the California Electric Code. Bond equipment racks to ground in accordance with the California Electric Code and ANSI/ EIA/ TIA 607 and Section 27 05 26

B. Unless otherwise noted maintain a unipoint ground scheme.

C. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.

END OF SECTION

PART 1 - PGENERAL

1.1 SCOPE OF WORK

A. This Section defines material standards for:

1. Copper Termination Assemblies, including
   a. Rack and cabinet mounted copper patch panels
   b. Backboard, rack and cabinet mounted terminal blocks

1.2 RELATED WORK UNDER OTHER SECTIONS

A. Section 27 05 00 – Common Work Results for Communications

B. Section 27 05 26 – Grounding and Bonding for Communications Systems

C. Section 27 10 00 – Structured Cabling, Basic Materials and Methods

D. Section 27 11 13 – Communications Entrance Protection

E. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures

F. Section 27 11 23 – Communications Cable Management

G. Section 27 15 00 – Communications Horizontal Cabling

1.3 REFERENCES:

1. ELECTRONIC INDUSTRIES ALLIANCE (EIA)
   a. EIA-310-D (1992) Cabinets, Racks, Panels, and Associated Equipment (ANSI/EIA/310-D)

1.4 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

PART 2 - PRODUCTS

2.1 COPPER CABLE TERMINATION DEVICES AND RELATED

A. Category 5e Terminal Block.

1. Drawing reference(s):
   a. 110TB100 100 pair
   b. 110TB300 300 pair

2. General: Insulation displacements connector blocks consisting of oxygen free mechanical fastening system arranged in a flame-retardant molded plastic fastened to a mounting bracket.
3. Features/Functions
    a. “110 type” punch down type.
    b. Cable routing space behind the blocks.
4. Conforms with TIA/EIA-568-B.2 Category 5e standard.
5. Construction/Implementation
    a. Provide complete with standoff mounting brackets
    b. Provide trough at the bottom of each column of blocks.
    c. Unless otherwise noted, provide WMP between each column of blocks, and at the outside edges of each group of block columns.
6. Manufacturer:
    a. Panduit. P110KT3004Y with P110VCM300.
    b. or equal.

B. Category 5e 19 in. Rack Mount Terminal Block

1. Drawing reference(s):
2. RM110TB200 200 pair
3. General: Insulation displacements connector blocks consisting of oxygen free mechanical fastening system arranged in a flame-retardant molded plastic fastened to a 19 in. rack mount panel.
4. Features/Functions
    a. “110 type” punch down type.
    b. Cable routing space behind the blocks.
5. Conforms with TIA/EIA-568-B.2 Category 5e standard.
6. Manufacturer:
    a. PanduitP110B1005R4WJY.
    b. Or equal.

C. Data Patch Panels, Category 6A, Modular

1. Drawing Reference(s): *** CXPP, where *** refers to port count and X to Category rating of ports.
2. Functions/Features:
    a. Flat, 19 in. EIA rack mountable.
    b. 48 ports per EIA rack unit (3.50 in.).

c. Industry standard RJ-45 jacks inserted in openings in steel plate
   1) arranged in rows on steel panel,
   2) jacks on front,
   3) terminations on rear.
   4) Patch panel and Port identifier label space on front – label per Section 27 05 53 - Identification for Communications Systems.

d. Each opening to be filled with jacks as specified in Section 27 15 00 - Communications Horizontal Cabling. Match the color coding specified. Provide blank panels on all unused ports.

3. Manufacturer

   a. Panduit DP246X88TGY (24 port) and DP486X88TGY (48port). Provide strain relief bar SRB19D7BL for each patch panel.

D. Cross-Connect Wire

1. Drawing Reference: None

2. Provide quantities of voice cross-connect wire in each Communications Room for use by the District's Staff as follows:

   a. 22 gauge, Solid Core

   b. USOC color coded

   c. Paired cables without overall jacket

   d. BDF/EF/ER
      1) One 1000 foot minimum spool - Yellow/Blue
      2) Two 1000 foot minimum spool - White/Red

   e. IDF/TR
      1) One 1000 foot minimum spool - Yellow/Blue
      2) One 1000 foot minimum spool - White/Red

3. Manufacturer

   a. Belden

   b. General

   c. Berk-Tek

   d. Superior/Essex

   e. or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Section 27 13 00 Communications Indoor Backbone Cabling for requirements for termination of Riser and Outside Plant Cabling within IDF/HC's, and BDF/EF's.

B. Refer to Section 27 10 00 – Structured Cabling, Basic Materials and Methods and Section 27 15 00 – Communications Horizontal Cabling.

END OF SECTION

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PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Section includes provision of cable management for cabling installed under the work of this Project as well as for Contractor furnished patch cords at equipment racks.

B. Scope includes:

1. Cable End Spillway
2. Backboard Cable Management
3. Patch Panel Cable Management at racks and cabinets

1.2 RELATED WORK IN OTHER SECTIONS

1. Section 27 05 33 – Conduits and Backboxes for Communications Systems
2. Section 27 05 53 – Identification for Communications Systems
3. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
4. Section 27 11 19 – Communications Termination Blocks and Patch Panels
5. Section 27 15 00 – Communications Horizontal Cabling

1.3 REFERENCES

1. American Society For Testing and Materials (ASTM)
2. ASTM D2239-03 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

B. Underwriters Laboratories (UL)

1. UL 910 Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables used in Spaces Transporting Environmental Air (Nov. 1998)

1.4 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

PART 2 - PRODUCTS

2.1 INNERDUCT

A. Woven Mesh Innerduct

1. Drawing Reference: WMID

2. Features/Functions

   a. Three inch wide woven mesh assembly contains at least three continuous pullable sleeves, each can accommodate a cable of at least 1" diameter.

   b. Systems providing fewer than 3 integrally woven sleeves per WMID assembly not acceptable.

   c. Includes color coded pull tape in each sleeve.

   d. Pre-Lubricated for cable pulling

   e. Non-Hydroscopic

   f. 2500 Pound Tensile Strength

   g. 480 degree melting point.

   h. At least 5 years prior field use including at least 25 million feet of product in use.

   i. Provide plenum rated assembly at plenum locations as defined by the National Electric Code.

3. Manufacturers:

   a. Maxcell/TVC 3" 3-cell in three unique colors per duct.

   b. or equal (No known equal with identical 3 sleeves woven into a single assembly nor equal industry usage).

2.2 CONDUIT CABLE MANAGEMENT

A. Conduit End Waterfall Spillway

1. Drawing Reference: CEW

2. Features/Functions

   a. Spillway fastens to end of EMT conduit, provides radius sweep, open on top, solid from below

   b. Maintains proper bend radii for fiber/cable

   c. Provides tie points for fire pillow retention

   d. Supports up to 100 lbs. of hanging fiber/cable

   e. Clamp for securing to EMT

   f. Self-fastening tie down system for supporting cabling

3. Construction:

   a. Fire Retardant ABS

4. Manufacturers:

   a. Bejed BJ-2049 Spillway.

   b. or equal (no known equal).

2.3 PATCH PANEL CABLE MANAGEMENT

A. Patch Panel Wire Management, Rack Mounted, Snap Cover.

1. Drawing References:
   a. 2 RU Version: WMP, Wire Management Panel
2. Construction
   a. EIA 19 in. Rack Mount, as required
   b. Continuous flexible system of fingers and slots along top and panel, deburred to avoid snagging patch cord jacket.
   c. Snap Cover
3. Capacity
   a. 2 RU - accommodates at least 70 patch cords.
4. Manufacturers:
   a. Panduit WMPH2.
   b. or equal.

2.4 BACKBOARD CABLE MANAGEMENT

A. Fiber Management Ring, Preformed Loop

1. Drawing Reference: FMR
2. Construction:
   a. 24 inch diameter steel ring stores fiber slack using Velco fasteners at regular intervals around ring.
   b. Screw fastens to backboard at BDF or IDF.
3. Manufacturer
   a. Leviton 48900-IFR for inside plant riser fiber and Leviton 48900-OFR for outside plant fiber.
   b. or equal (no known equal)

B. Wire Management Rings, Wall/Ceiling Mounted:

1. Drawing References/Functions Features:
   a. WMRB - Bridle Ring Type, Threaded Lag Screw
   b. WMRC - Closed Ring, U shaped assembly with two screw holes at ends,
   c. WMRO - Open, Re-enterable Split Ring permitting cables to be inserted midspan, two screw holes at ends
   d. WMP** - Steel back board with 4 inch deep min, 8 inch wide vertical wire management rings, front enterable. Provide trough at bottom of each column of WMP.

e. WMP**T - Narrow, steel back board with 4 inch deep min, 3 inch wide vertical wire management rings, front enterable.

2. Provide as required to support indicated cable bundle and location.

3. Provide type WMRB at wood frame construction for cable hung from underside of ceiling, unless otherwise noted.

4. Manufacturers:

a. WMRB:
1) B-Line Fasteners, BR Series
2) Senior Industries
3) T&B
4) or equal.

b. WMRC
1) Chatworth Products Wall Mount Closed D Ring.
2) Senior Industries
3) or equal.

c. WMRO
1) Chatworth Products Wall Mount Open Ring.
2) AllenTel
3) Commscope/Systimax, Inc.
4) Siemon
5) or equal.

d. WMP
1) Siemon S188-*** to match adjacent terminal blocks with S188-WD
2) Ortronics OR-806003194 or OR-806003196 to match terminal blocks.
3) By any manufacturer listed for 110TB under Section 27 11 19 – Communications Termination Blocks and Patch Panels
4) or equal.

e. WMP**T

f. Siemon S110M-WM-*** to match adjacent terminal blocks

g. By any manufacturer of listed for 110TB under Section 27 11 19 – Communications Termination Blocks and Patch Panels

h. or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Section 27 13 00 Communications Indoor Backbone Cabling for requirements of cable routing within IDF/HC's, and BDF/EF's.

3.2 CONDUIT END WATERFALL

A. Fasten securely to conduit end wherever cabling will exit conduit 18 in. or more above the cable tray to prevent damage due to cabling due to weight of cable bearing on a conduit end.

B. Secure cabling with integral cable restraint system.

END OF SECTION

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PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Work of this Section includes:

1. Indoor Copper Backbone Cabling between Communications Rooms and communications terminal nodes other than station cabling.

2. Terminate copper cabling on terminal blocks as specified in Section 27 11 19. Provide terminal block, high pair count copper connector cabling and rack mounted patch panels to permit District's telephone contractor to cross-connect the entrance and riser cabling to individual station ports using District furnished patch cords.

3. For all cabling:

a. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 27 10 00.

b. Label cables, jacks, plates and patch panels as specified in Section 27 05 53.

c. Document on Record Documents as described in Section 27 05 00.

B. Related work in other Sections

1. Section 27 05 29 – Hangers and Supports for Communications Systems

2. Section 27 05 33 – Conduits and Backboxes for Communications Systems

3. Section 27 05 53 – Identification for Communications Systems

4. Section 27 10 00 – Structured Cabling, Basic Materials and Methods

5. Section 27 11 19 – Communications Termination Blocks and Patch Panels

6. Section 27 11 23 – Communications Cable Management

7. Section 27 15 00 – Communications Horizontal Cabling

1.2 REFERENCES

A. Refer to Section 27 10 00 – Structured Cabling, Basic Materials and Methods

1.3 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

PART 2 - PRODUCTS

2.1 FIBER OPTIC COMMUNICATIONS CABLING AND RELATED:

A. Fiber count per cable to comply with minimum counts indicated on the plans. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.

B. FIBER, SINGLEMODE - GENERAL

1. Meeting EIA/TIA 568

2. Construction:

a. Standards Compliance ITU-T G.652.D | ITU-T G.657.A1 | TIA-492CAAB (OS2)

b. Attenuation, maximum 0.22 dB/km @ 1,550 nm | 0.23 dB/km @ 1,575 nm | 0.25 dB/km @ 1,490 nm | 0.25 dB/km @ 1,625 nm | 0.31 dB/km @ 1,385 nm | 0.34 dB/km @ 1,310 nm | 0.35 dB/km @ 1,650 nm

c. Dispersion, maximum 18 ps(nm-km) at 1550 nm | 3.5 ps(nm-km) from 1285 nm to 1330 nm at 1310 nm

d. Mode Field Diameter 10.4 µm @ 1,550 nm | 9.2 µm @ 1,310 nm | 9.6 µm @ 1,385 nm

e. Mode Field Diameter Tolerance ±0.3 µm @ 1310 nm | ±0.5 µm @ 1550 nm | ±0.6 µm @ 1385 nm

f. Index of Refraction 1.467 @ 1,310 nm | 1.468 @ 1,385 nm | 1.468 @ 1,550 nm

g. Polarization Mode Dispersion Link Design Value, maximum 0.04 ps/sqrt(km)

h. Cladding Diameter 125.0 µm

i. Cladding Diameter Tolerance ±0.7 µm

j. Cladding Non-Circularity, maximum 0.7 %

k. Coating Diameter (Colored) 253 µm

l. Coating Diameter (Uncolored) 240 µm

m. Coating Diameter Tolerance (Colored) ±7 µm

n. Coating Diameter Tolerance (Uncolored) ±5 µm

o. Coating/Cladding Concentricity Error, maximum 12 µm

p. Core/Clad Offset, maximum 0.5 µm

q. Cabled Cutoff Wavelength, maximum 1260 nm

r. Point Defects, maximum 0.10 dB

s. Zero Dispersion Slope, maximum 0.090 ps/[km-nm-nm]

t. Zero Dispersion Wavelength, maximum 1322 nm

u. Zero Dispersion Wavelength, minimum 1302 nm

3. Manufacturer:
   a. Corning OS2 Singlemode Fiber
   b. Or equal

C. FIBER OPTIC CABLE CONSTRUCTION, GENERAL

1. All Dielectric, unless otherwise noted.
2. Color Code:
   a. Per EIA/TIA-598A.
   b. Colors shall be across specified storage/installation temperature range.
   c. Means of providing conforming colors shall not degrade performance of cable.
3. Jacket:
   a. Free of splits, holes or blisters.
   b. Marked in conformance with NEC 350G
4. Heavy duty construction, Fiberglass Epoxy Rod/Kevlar strength member(s).
5. Each fiber to be 100% attenuation tested by the Manufacturer prior to shipping to indicate conformance of shipped cable to requirements herein. Manufacturer's test to be affixed to shipping reel.
6. Performance:
   a. Temperature Sensitivity:
      1) Storage: -40C° to +70C°.
      2) Installation: -30C° to +70C°.
      3) Variance:
         a) Single Mode: Average change, not more than 0.05 dB/km at 1550 -40C° to +70C°. Maximum change not more than 0.15 dB/km at 1550 nm.

D. Fiber Optic Cable, Plenum Rated:

1. Drawing References:
   a. XX FOS-P Singlemode, Plenum where XX indicates fiber count.
2. Fiber: Refer to
   a. FIBER, SINGLE MODE, GENERAL, as shown in this section.
3. Application: Intra-building distribution in building plenum and duct space
4. Listing: Meeting NEC OFNP, Listing by nationally recognized testing agency.
5. Construction:
   a. Refer additionally to Fiber Cable Construction, General, elsewhere herein.

b. Jacket: Subject to listing and rating for plenum cable.

c. Tight Buffer construction only, “Core Lock” not required.

d. Dimensions, not to exceed the following:
   1) 1 to 4 Fibers: 0.20"
   2) 5 to 12 Fibers: 0.28"
   3) 12 to 24 Fibers: 0.50"
   4) 25 to 60 Fibers: 0.80"
   5) 61 to 108 Fibers: 0.90"
   6) 109 to 144 Fibers: 1.10"

6. Mechanical Specifications
   a. Min. Bend Radius Installation 75 mm (2.95 in)
   b. Min. Bend Radius Operation 50 mm (1.97 in)
   c. Max. Tensile Strength, Long-Term, ≤12F 132 N
   d. Max. Tensile Strength, Long-Term, >12F 200 N
   e. Max. Tensile Strength, Short-Term, ≤12F 440 N
   f. Max. Tensile Strength, Short-Term, >12F 660 N
7. Cable Design
   a. Central Element Yarn
   b. Outer Jacket Color Yellow
   c. Outer Jacket Material Flame-retardant
8. General Specifications
   a. Environment Indoor
   b. Cable Type Tight-Buffered
   c. Fiber Category Single-mode (OS2)
   d. Flame Rating Plenum (OFNP)
9. Manufacturer:
   a. Corning MIC Tight-Buffered Plenum, Single Mode (OS2)
   b. Or equal

2.2 COPPER BACKBONE CABLING

A. General

1. Each conductor shall be a minimum of 22 or 24 AWG.
2. Complies with
   a. ICEA S-90-661
   b. EIA TIA/EIA-568-B.1

c. EIA TIA/EIA-568-B.2

d. NEMA WC 63.1

e. UL 444

3. Solid conductor 100 ohm multipair UTP (Unshielded twisted pair), formed into 25 pair binder groups covered with a gray thermoplastic jacket.

4. Imprinted with

a. Manufacturers name or identifier,

b. Flammability rating,

c. Gauge of conductor,

d. Transmission performance rating (category designation)

e. At regular intervals not to exceed 2 feet.

5. The word "FEET" or the abbreviation "FT" shall appear after each length marking.

6. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.

a. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.

7. Color coding shall comply with industry standards for 25 pair cables.

B. Inside Distribution Wire, Horizontal

1. Drawing Reference ** pr. T-IDW, where ** refers to required pair count.

2. Construction:

a. 2 to 600 pair count voice pair cabling in overall jacket.

b. Meets EIA/TIA Category 3

c. USOC color code.

d. NEC Type CM or CMG.

e. Nominal Outside Diameter, not to exceed the following:

Pair Count	Outside Diameter (inches)
6 pr.	0.23
12 pr.	0.25
25 pr.	0.34
50 pr.	0.47
100 pr.	0.64
200 pr.	0.97
300 pr.	1.07
400 pr.	1.30
600 pr.	1.50

3. Manufacturer:
    a. Superior/Essex
    b. General Cable
    c. Mohawk
    d. NORDX/CDT
    e. or equal.

PART 3 - EXECUTION

3.1 COPPER BACKBONE TIE CABLE INSTALLATION AND TERMINATION

A. General:

1. Backbone cable(s) shall be installed in conduit system unless otherwise noted.

B. Sequencing:

1. If the installation of a tie cable requires the disconnection and removal of any existing cable(s) carrying active service prior to installation
    a. Notify the District's Representative no less than 5 working days in advance of when this work is to be performed.
2. When this work is performed, the newly installed cables must be installed, tested and passed in one 24 hour period beginning when the active service on the existing cable is interrupted.

C. Installation of Tie Cable:

1. All tie cable between terminal blocks at IDF/HC rooms shall be continuous, unspliced runs.
2. Termination of Voice or Shared Use Tie Cable:
    a. Cable shall be terminated on the 110 Type punch blocks system using C4 connecting blocks in the following order.
        1) Terminate pairs and groups in order top to bottom and then left to right according to insulation or binder color as listed below.
        2) "Mate" is the first wire of the pair to be terminated, "Wire" is the second.
    b. Comply with the following table:

Group or Pair Number	Mate	Binder or Wire
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Slate
6	Red	Blue

7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Slate
11	Black	Blue
12	Black	Orange
13	Black	Green
14	Black	Brown
15	Black	Slate
16	Yellow	Blue
17	Yellow	Orange
18	Yellow	Green
19	Yellow	Brown
20	Yellow	Slate
21	Violet	Blue
22	Violet	Orange
23	Violet	Green
24	Violet	Brown
25	Violet	Slate

3. Cables containing pair counts of 50 or greater shall be terminated as follows:
    1) Columns of punch blocks stacked 2 high shall be mounted on the backboard.
    2) Beginning at the top right of the 1st column, first the blue binder will be punched down, followed by the orange binder directly beneath it.
    3) Binder punch will continue top to bottom, and then left to right until the entire cable has been terminated.
    4) Thus a 50-pair cable requires two punch blocks.

b. Upon completing the termination of all cables within an IDF/HC, install a clear plastic cover at each punch block.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Work of this Section includes:

1. Outdoor (Outside Plant) Communications Cabling placed underground in new and existing communications ducts between the MDF and IDF's of this Project selected pedestal locations, including:
    a. High pair count copper cabling
    b. Fiber Optic Cabling
2. Terminate fiber on patch panels as specified in Section 27 11 19.
3. Terminate copper cabling on lightning protectors as specified in Section 27 11 13.
4. For all cabling:
    a. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 27 10 00.
    b. Label cables, jacks, plates and patch panels as specified in Section 27 05 53.
    c. Document on Record Documents as described in Section 27 05 00.

B. Related work in other Sections

1. Section 27 05 26 – Grounding and Bonding for Communications Systems
2. Section 27 05 29 – Hangers and Supports for Communications Systems
3. Section 27 05 33 – Conduits and Backboxes for Communications Systems
4. Section 27 05 36 – Cable Trays for Communications Systems
5. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems
6. Section 27 05 48 – Noise and Vibration Controls for Communications Systems
7. Section 27 05 53 – Identification for Communications Systems
8. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
9. Section 27 11 13 – Communications Entrance Protection
10. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
11. Section 27 11 19 – Communications Termination Blocks and Patch Panels
12. Section 27 11 23 – Communications Cable Management
13. Section 27 13 00 – Communications Interior Backbone Cabling

14. Section 27 15 00 – Communications Horizontal Cabling

1.2 REFERENCES

A. Usage: In accordance with Division 1.

B. In addition to the requirements of Section 27 05 00 - Common Work Results for Communications Systems and 27 10 00 - Structured Cabling, conform to the applicable portions of the following standards agencies:

1. BICSI
    a. Customer Owned Outside Plant Design Manual, 6th Edition
2. Insulated Cable Engineers Association (ICEA)
    a. ICEA S-56-434 (1983, 5th Ed.) Polyolefin Insulated Communication Cables for Outdoor Use.
3. Underwriters Laboratories, Inc. (UL)
    a. UL 497 (1995, R 2001) Safety(Dec. 15, 1978, 4th Ed.; Rev. thru Oct. 9, 1990) Protectors for Communications Circuits
4. U.S. Department of Agriculture, Rural Utilities Service (RUS), formerly Rural Electrification Administration (REA):
    a. RUS/REA Bulletin(Jan. 1993; Supp 1 thru 7) 1755l-100 List of Materials Acceptable for Use on Telephone System of REA Borrowers.
    b. RUS (REA) PC-2(Jan. 1978) Splicing Standard.
    c. RUS (REA) PC-4(July 1976) Acceptance Tests and Measurements of Telephone Plant.
    d. RUS (REA) PE-22(No. 1982) Aerial and Underground Telephone Cable.
    e. RUS (REA) PE-33(Mar. 1985) Shield Bonding Connectors.
    f. RUS (REA) PE-39(June 1993) Filled Telephone Cables.
    g. RUS (REA) PE-60(Sep. 1979) Trunk Carrier Systems.
    h. RUS (REA) PE-74(Oct. 1985) Filled Splice Closures.
    i. RUS (REA) PE-87(Dec. 1983) Terminating (TIP) Cable.
    j. RUS (REA) PE-89(June 1993) Filled Telephone Cable with Expanded Insulation.
    k. RUS (REA)TECM 644(Apr. 1983; Issue No.3) Design and Construction of Underground Cable (Physical Plant).
    l. RUS (REA)TECM 823(Aug. 1980; Issue No. 3) Electrical Protection by Use of Gas Tube Arrestors.
    m. SUBMITTALS

C. Conform with the requirements of Division 1 and Section 27 05 00 - Common Work Results for Communications Systems.

1.3 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Division 1 and Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

PART 2 - PRODUCTS

2.1 FIBER OPTIC CABLING

A. Fiber Optic Cable, Indoor Plenum/Outdoor Rated:

1. Drawing References:
   a. XX FOS-OPP Singlemode, Indoor Plenum/Outdoor, where XX indicates fiber count.
2. Fiber: Refer to:
   a. FIBER, SINGLE MODE, GENERAL, as specified under section 27 13 00.
3. Application: Inter-building site distribution in manholes and site conduit. Conform to NEC and CEC limits on placement within building envelope.
4. Listing: NEC OFNP, Listing by nationally recognized testing agency.
5. Construction:
   a. Refer additionally to Fiber Cable Construction, General, elsewhere herein.
   b. Suitable and Code approved for wet location installed inside duct.
   c. Provide Loose Tube Gel Free Construction Water Blocking Construction.
   d. Mechanical Specifications
      1) Max. Tensile Strength, Long-Term 810 N
      2) Max. Tensile Strength, Short-Term 2700 N
      3) Min. Bend Radius Installation 171 mm (6.73 in)
      4) Min. Bend Radius Operation 114 mm (4.49 in)
   e. Cable Design
      1) Central Element Dielectric
      2) Buffer Tube Color Coding Yellow
      3) Number of Ripcords 2
      4) Outer Jacket Color Black
      5) Outer Jacket Material Flame-Retardant, UV-Resistant
      6) Tensile Strength Elements and/or Armoring Layer 1 - Dielectric strength members
      7) Fiber Coloring Blue, Orange, Green, Brown, Slate, White, Red, Black, Yellow, Violet, Rose,Aqua
      8) Fibers per Tube 12
   f. General Specifications
      1) Environment Indoor/Outdoor
      2) Cable Type Loose Tube
      3) Product Type Dielectric

4) Fiber Category Single-mode (OS2)
5) Flame Rating Plenum (OFNP)
6) Application Aerial , Direct Buried , Duct , General Purpose Horizontal

6. Manufacturer
   a. Corning FREEDM Loose Tube, Gel Free, Plenum Single Mode (OS2)
   b. Or equal

2.2 FIBER OPTIC SPLICE CLOSURE, OUTSIDE PLANT RATED

A. Drawing Reference: FOSC-OP

1. Functions/Features:
   a. Supports stranded loose tube or ribbon fiber cables in either armored or dielectric configurations.
   b. Fully sealed to protect fiber and splices
   c. Re-enterable underground up to 5 meters.
   d. Fusion splice protection chamber
   e. Designed and tested to Telcordia GR-771 requirements
   f. Rural Utilities Service (RUS) Listed
2. Manufacturers
   a. AFL LightGuard 250. Provide splice trays, cable grounding kits and hanger brackets.
   b. Commscope FOSC450. Provide splice trays, cable grounding kits and hanger brackets.

2.3 COPPER OSP CABLING

A. Telephone, Outside Plant, Underground in Ductbank

1. Drawing Reference: T-OPD, with pair counts as indicated.
2. Features/Functions:
   a. Solid round copper wire.
   b. Solid aluminum tape overall shield.
   c. Gel filled.
   d. Polyethylene Overall Jacket.
   e. Suitable for direct burial.
3. Manufacturer:
   a. Alcatel
   b. Superior/Essex
   c. General Cable

d. NORDX/CDT

e. Any meeting REA PE-39 for cable smaller than 400 pair,

f. Any meeting REA PE-39 or REA PE-89 for cable 400 pair or larger.

g. or equal.

B. Shield Connectors:

1. Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire.

2. The connector shall be made of tin-plated tempered brass.

3. Shield bond connectors shall comply with REA PE-33.

C. Grounding Braid:

1. Grounding braid shall provide low electrical impedance connections for dependable shield bonding.

2. The braid shall be made from flat tin-plated copper.

2.4 OUTSIDE PLANT TELEPHONE CABLING CLOSURES

A. In Building Telephone Closure:

1. Drawing Reference: IBTC

2. Features and Functions:

a. Provides transition point from unlisted, gel-filled Outside Plant Cabling to Interior (T-IDW) cabling

b. Can house a straight, butt, and branch splice in a protective housing.

c. Not pressurized or encapsulated.

d. Fire-retardant Plastic construction, meeting PUB55006 for interior (in-building) installation.

e. RUS (formerly REA) listed for application.

f. Provide a suitable means for mounting to backboard.

3. Manufacturer:

a. 3M K&B Series

b. Preformed Line Products Coyote Splice Case

c. or equal.

B. Telephone Closure, Outside Plant

1. Drawing Reference: TSC-OP

2. Features/Functions

a. Can house a straight, butt, and branch splice in a protective housing.

b. Rigid outer protective body

c. Suitable for periodic water immersion - air and watertight.

d. Renter able.

e. Gel Filled, Injected encapsulant using precision means

3. Manufacturer:

a. 3M 900 Series Direct Injection

b. Preformed Line Products Armadillo Stainless

c. or equal.

C. Multipair Splicing Connectors

1. Drawing Reference:None. Provide at all IBTC, OTC and similar locations where shown on the plans or required in the field.

2. Function:

a. Can gas tight terminate large pair counts of copper cabling to connectorized ends and reliable mate ends in compact area.

b. Industry standard termination means.

3. Manufacturer:

a. 3M 710 (Industry standard item)

b. or equal (no known equal).

2.5 BOLLARD/PEDESTAL WIFI ENCLOSURE

A. Drawing References: PW1

B. Features/Functions:

1. Design: Cylindrical polyethylene plastic Wi-Fi bollard. Designed to protect APs and antennas in outdoor public spaces. Fiberglass interior equipment stand for mounting APs and antennas minimizes impact on wireless signals.

2. Performance: Designed to protect equipment from tampering, spilling liquids and weather. NEMA 3R performance for indoor/ outdoor environments.

3. Anchors to pre-installed concrete pedestal.

4. Available in 14 standard colors

5. Includes anchor base, equipment stand, hardware to fasten APs and antennas. Tamper resistant hardware

6. Construction:

a. Nominally 0.25 in. thick, UV and cleaning chemical resistant UL-94HB Polyethylene plastic.

b. Zinc coated, 0.25 in. thick steel anchor base.

c. Fiberglass equipment mounting stand.

d. Size:
   1) Up to 60 in. (1,524 mm)
   2) 11.5 in. (292 mm) inner diameter
   3) Anchor base is 10.9 in. (305mm) diameter

7. Manufacturers:

   a. Oberon Model 3032-LH-xx-48 (Lighthouse). Selection of finish by Architect. Submit for approval.

   b. No known equal.

2.6 MISCELLANEOUS UNDERGROUND PRODUCTS

A. Pull Rope

1. 1/4 inch diameter polyethylene.

2. 200 pound strength.

3. Manufacturers:

   a. Carlon Telecom Systems.

   b. Vikimatic

   c. or equal.

B. Length Marked Tape

1. Provide 1/2 inch flat tape with sequential markings in whole feet.

2. Manufacturers:

   a. Carlon Telecom Systems.

   b. Greenlee

   c. Vikimatic

   d. or equal.

C. Conduit Plugs

1. Provide universal blank duct plug type, with eye for tying rope and tape.

2. Manufacturers:

   a. Carlon Telecom Systems.

   b. Condux International, Inc.

   c. or equal.

D. Bonding Ribbon:

1. Annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated.

2. Manufacturer:
    a. Inwesco 12A55
    b. Corning Cable Systems
    c. Preformed Line Products.
    d. or equal.

E. Bonding Ribbon Clamp:
1. Soft lead
2. 1/16 inch thick
3. Bolt hole for attachment
4. Manufacturer:
    a. Inwesco 12A56
    b. Corning Cable Systems
    c. Preformed Line Products.
    d. or equal.

F. Fargo Clamp:
1. Cast copper, silver plated, furnished with copper bolt.
2. RUS Listed
3. Manufacturer:
    a. Allied Bolt
    b. Inwesco 12A57
    c. Corning Cable Systems
    d. or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide safety barriers and flag persons for all open manholes and pullboxes that are located in areas accessible to the public.

B. Provide traffic control in accordance with the requirements of Division 1.

C. Conform to OSHA guidelines when accessing manholes and handholes, inclusive of the requirement for air sampling. Provide continuous measurements. Provide the Owner's Representative with contractor maintained logs of air samples taken at most two hours apart.

D. Provide sufficient personnel to permit one individual to remain above the surface at all times, in visual contact with persons in manholes and similar. Provide the observer with a appropriate means of obtaining assistance.

E. Provide ladders for access to manholes. Do not permit workers to use cables or splice cases as ladders.

F. Install a 3/8 in. nylon pullrope with all underground cables.

3.2 CABLE PULLING.

A. Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables.

B. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation.

C. Use flexible cable feeds to convey cables through manhole opening and into duct runs.

D. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop.

E. Maintain minimum allowable bending radii in forming such loops.

F. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into outdoor pedestals or other enclosures.

G. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable.

H. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.3 CABLES IN MANHOLES, PULL BOXES AND HANDHOLES.

A. Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths.

B. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators.

C. In existing manholes and handholes where new ducts are to be terminated or where new cables are to be installed, locate the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported.

D. Support cable splices in underground structures by racks on each side of the splice.

E. Located splices to prevent cyclic bending in the spliced sheath.

F. Install cables at middle and bottom of cable racks, leaving top space opening or future cables, except as otherwise indicated for existing installations.

3.4 SERVICE LOOP AND TRANSITION SPLICE AT BUILDING ENTRY

A. For outside plant, flooded cables of 100 pair or greater entering a BD or EF, provide a transition in a splice case, Type IBTC, to non-flooded cable prior to termination on the protector blocks. Unless otherwise indicated on the plans, position the splice case high on the backboard, parallel to the floor at location suitable for service and where gel will not be drawn from the serving outside plant cabling into the IBTC.

B. At IDF's and BDF's, at both ends of cables, provide at least 20 feet of cable in excess of that required to reach the protectors or terminal block by a dressed route. Form into a storage loop, typically around the perimeter of the backboard and fix in place as directed by the Owner's Representative.

C. Refer to Section 27 13 00 Communications Indoor Backbone Cabling for additional requirements for termination within IDF's, BDF's and Telecommunication Building.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes, but is not necessarily limited to provision of:

1. Horizontal Station Cabling

a. Horizontal copper station cabling, meeting ANSI/TIA Category 6A standards, homerun from receptacles to indicated IDF or BDF. Terminated on rack mounted patch panels, as indicated.

2. For all cabling:

a. Terminate on patch panels as specified in Section 27 11 19 – Communications Termination Blocks and Patch Panels.

b. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 27 10 00 - Structured Cabling – Basic Materials & Methods.

c. Label cables, jacks, plates and patch panels as specified in Section 27 05 53 – Identification for Communications Systems.

d. Document on Record Documents as described in Section 27 05 00 – Common Work Results for Communications.

B. Related Documents:

1. Specification Section 27 05 00 – Common Work Results for Communications applies to this Section.

C. Related Work in Other Sections:

1. Section 27 05 29 – Hangers and Supports for Communications Systems

2. Section 27 05 33 – Conduits and Backboxes for Communications Systems

3. Section 27 05 53 – Identification for Communications Systems

4. Section 27 11 19 – Communications Termination Blocks and Patch Panels

5. Section 27 11 23 – Communications Cable Management

1.2 REFERENCES

A. As listed in Section 27 05 00 - Common Work Results for Communications and 27 10 00 - Structured Cabling.

1.3 SUBMITTALS

A. Conform with the requirements of Section 27 05 00 - Common Work Results for Communications.

1.4 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 27 05 00 - Common Work Results for Communications.

PART 2 - PRODUCTS

2.1 COPPER CABLING, CATEGORY RATED DATA/VOICE

A. General

1. Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with ANSI/TIA 568-B.1.

B. High Speed, ANSI/TIA Category Cabling, UTP, Plenum Rated

1. Drawing Reference:** UTP6A-4P, where ** denotes cable count

2. Construction:

a. Provide horizontal copper cable in accordance with:
1) ISO 11801 Class EA
2) ANSI/TIA-568-C.2 Category 6A standards for swept frequencies up to 500 MHz

b. UTP (unshielded twisted pair), 100 ohm impedance

c. Conductors/insulators: 23 AWG solid bare copper wire covered by HDPE and Foam PE insulation

d. Nominal Cable Diameter: 0.23 in.

e. Cable jacket: FEP plenum (CMP) flame retardant PVC

f. PoE compliance: Meets IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for PoE applications

g. Installation tension: 110 N (25 lbf) maximum

h. Color: Blue

3. Manufacturers:

a. Panduit Category 6A UTP Copper Cable PUP6AHD04BU-G (PCCD Standard).

2.2 TELECOMMUNICATIONS OUTLETS

A. Category 6A Data Jacks Performance Requirements, General

1. Jack

a. Construction:
1) High impact, flame retardant UL-rated 94V-0 thermoplastic.

2) The jack shall be designed with an integral locking mechanism which, upon insertion of a modular plug, provide maximum pullout strength at the plug/jack interface.

b. Performance - The jack shall meet or exceed the following standards.
   1) Meet or exceed requirements of ANSI/TIA-568-C.2 Category 6A, IEEE 802.3an-2006, and ISO 11801 Class E channel standards.
   2) UL listed

c. Physical - The modular jacks shall meet the following physical requirements.
   1) Terminate 4-pair, Wire cap compatible with 22 – 26 AWG solid or stranded cable with conductor insulation diameters of 0.060 in. max and overall cable O.D. of 0.200 in. to 0.330 in.
   2) Color: Blue
   3) Blank jack cover: White to match plate.

2. Manufacturers – Cat 6A Jacks:
   a. Panduit Mini-Com TX6A Jacks. Part no. CJ6X88TGBL (PCCD Standard).

3. Manufacturers - Blank Module.
   a. Panduit Mini-Com Blank Module CMBIW-X
   b. or equal.

B. Telecommunications Outlets, New, Copper Jacks, Wall Mount,Flush

1. Drawing Reference(s):
   a. MMP6

2. Assembly. Provide complete telecommunications outlet assembly, including but not limited to:
   a. Shall be able to fit the jack as specified above.
   b. Blank connector modules at faceplate openings not filled with connector modules.
   c. Labels and label holders.

3. Faceplate.
   a. Features:
      1) Single gang.
      2) Front Loading
      3) Openings for up to 6 jack connector modules –MMP6.
      4) Label holders with space to label the plate number and the number of each jack.
   b. Color: White.

4. Manufacturers:
   a. Panduit
      1) 4 port: CFPL4WHY

2) 6 port: CFPL6WHY
3) or equal.

C. Voice Telephone, Station Plates & Jack/Receptacles:

1. Drawing References:
   a. Wall Mounted Telephone, Flush:
   b. 630A
2. Station jacks shall be modular four or 8 wire type and conform to FCC Part 68.
3. Construction, where not otherwise specified, scheduled or indicated:
   a. Cat 6A Modular as specified above.
   b. Jack is fully recessed behind plate.
   c. Spring Wire Contacts, at least 50 microinches gold on 100 microinches nickel.
   d. Mechanically fastened to Building or Similar. Adhesive fastening not acceptable.
   e. Stainless Steel.
   f. Mounts to Single Gang Ring.
   g. Single Gang Wall Plate with two integral wall telephone mounting studs.
   h. Insulation displacement (punchdown) termination.
4. Manufacturers, Flush Wall Mounted Wall Telephone.
   a. Panduit KWP6PY
   b. or equal.

D. Small Diameter Category 6A Patch Cords – One patch cord per patch panel port and one patch cord per station jack including WAPs and CCTV cameras. Verify length of patch cords required after patch panels and switches have been installed. Verify length of patch cords required in the field and to be confirmed after furniture or device installation. Exact counts to be coordinated with UCB ITS before ordering. Provide 10% of the total count for spare.

1. Color
   a. Data: Blue
   b. Wireless Access Point: Yellow
   c. Security Camera: Green
2. Manufacturers:
   a. Panduit TX6A-28 Cat 6A Small Diameter Patch Cord.

E. Singlemode Fiber Patch Cords - One patch cord per patch panel port. Verify length of patch cords required after patch panels and switches have been installed. Provide 20% of the total count for spare.

1. Manufacturers:
    a. Panduit LC-LC duplex patch cords.
    b. Or equal

PART 3 - EXECUTION

3.1 SIGNAL POLARITY AND COLOR CODE CONVENTION

A. Category 6A Station Wire, RJ45 - Per EIA/TIA-568, designation T568 B.

3.2 STATION CABLE INSTALLATION AND TERMINATION PROCEDURES

A. General:

1. All station cable, between the station outlets and the IDF terminal blocks, shall be continuous unspliced runs.
2. Station cable shall run loose throughout all pathways. At no time shall any station cable be secured by a tywrap, electrical tape or similar bindings.
3. At Cable Trays in Communications Rooms, bundle station cable loosely into a bundle using velcro wraps applied at 3 ft o.c. typically. At no time permit the cables to be deformed by such cable bundling.

B. Run Lengths:

1. Station, Horizontal and IDF/HC Links:
    a. Horizontal Distribution runs (including vertical portions) shall not exceed 295 feet from station outlet to the associated communications closet.
    b. Station cabling runs to be 10 feet) or less.
    c. IDF/HC room distribution wiring not to exceed 19.5 feet
    d. Alternately, total length not to exceed 328 feet.
    e. Report to the Owner’s Representative conditions exceeding these requirements.
2. Limit cable bends to a minimum radius of 8 times cable diameter except where otherwise noted herein.
3. Service loop
    a. Copper. Provide 3 feet of slack at the station outlet end.
    b. Fiber. Provide 10 feet of slack at the MDF/IDFand at the station outlet end.
4. Termination of wiring at the station outlet:

a. All data and voice station cable shall be terminated at the individual receptacle modules in accordance with EIA/TIA-568-B, assignment T568B.

b. Termination of wiring at existing station outlets:
   1) Install in data and voice inserts in place of existing blank insert in existing faceplate.
   2) Install new labels and label holders.

5. Termination of station wiring at the IDF/HC

   a. For the installation/layout of station cable within the IDF/HC rooms, see detail on drawings.

   b. All Category 6A station cables entering the IDF/HC room will be terminated on a Category 6A RJ45 jack mounted in a Patch Panel as specified in Section 27 11 19 – Communications Termination Blocks and Patch Panels.

   c. Fiber station cabling will similarly be terminated on rack mounted patch panels.

   d. Termination shall begin at the upper left corner of the path panel and proceed to the right continuing down, left to right until all cables are terminated.

   e. All 4 port stations are to be terminated in the patch panel first, followed by the 2 port stations, then single port phones. Verify layout prior to termination with UCB Representative.

END OF SECTION

PART 1 - GENERAL

1.1 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. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:

1. 26 00 00 Electrical

2. 26 05 00 Common Work Results for Electrical

C. The system and all associated operations shall be in accordance with the following:

1. California Building Code, 2019 Edition

2. California Electrical Code, 2019 Edition

3. Local Jurisdictional Adopted Codes and Standards

4. ADA Accessibility Guidelines

1.2 SUMMARY

A. The Command Center is to be located at a central control point on the first floor or as determined by local Authority Having Jurisdiction. RATH® Command Center Call Boxes are to be located on all floors above the first floor, in the elevator landing on each floor.

B. The Command Center must include visual indicators to allow rescue personnel to know which Call Box needs assistance. The Command Center must allow rescue personnel to speak to each Call Box individually. The Command Center must include both a handset and speakerphone to communicate back to the Call Boxes.

C. The emergency communication hardware shall comply with the Americans with Disabilities Act (ADA). The Call Boxes shall have the ability to be programmed with up to 2 emergency phone numbers (either both off-site or Base Station and one off-site). Upon activation of the emergency push button, a call will be automatically placed to the Command Center. If no one answers at the Command Center, the Call Box must dial a secondary location outside the building to activate two-way off-site person to person voice communications via landline, cellular device (part # 2100-LTEGSM4/2100-LTEVER4), or IP (part # 2100-VOIP2CS).

1.3 DEFINITIONS

A. ADA: Americans with Disabilities Act

B. AHJ: Authority Having Jurisdiction

1.4 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

1. Submit product data sheets. Include operation manuals.

2. Wiring or shop diagrams detailing wiring schematics, cabling.

PART 2 – PRODUCTS

2.1 ACCEPTABLE EQUIPMENT

A. The Command Center (2500 series) shall include both the Base Station and Distribution Module. The Base Station must have a powder coated steel housing (surface or flush mount) or be desk mounted, include a black handset with coil cord and be powered from the Distribution Module.

B. Distribution Module must be a surface mount enclosure, include connections for the Call Boxes and power both the Base Station and 2400 series Call Boxes. The Distribution Module shall be powered from 120vac power with a battery backup that provides power for a minimum of 4 hours (part # RP7700104, 2500-PWRUPS, or RP7701500).

C. The Call Boxes (2400 series) must be in full compliance with ADA requirements. Call Boxes require a hands-free speakerphone with an LED to indicate status of call.

D. The Call Boxes must allow the programming of a specific location message of the unit. This allows rescue personnel to know the location of the activated Call Box.

E. The Call Boxes are to be located no higher than 48” front reach, or 54” side reach to the center of the button above ground level to ensure conformance with the ADA requirements.

F. The Call Boxes must have a Braille face plate to ensure conformance with the ADA requirements.

G. The Command Center must provide an audible and visual indicator that a Call Box has been activated.

H. The 120vac Power Supply RATH® part # RP7700104, 2500-PWRUPS, or RP7701500 must be capable of supplying power to the Distribution Module.

I. The Command Center is to be mounted on a flat wall surface or a desktop.

J. The Call Boxes are to be wall, surface or flush mounted.

PART 3 – EXECUTION

3.1 ELECTRICAL

A. The Command Center and Call Boxes (2400 series) are to be powered by the Distribution Module (Note: 2100 series require separate power).

B. Distribution Module shall be powered by the RATH® part # RP7700104, 2500-PWRUPS, or RP7701500 Power Supply. It shall require 120vac power and provide battery backup capable of providing a minimum of 4 hours of electrical backup in case of building power failure.

C. The Base Station shall connect to the Distribution Module with single wire pair.

D. Each Call Box shall connect to the Distribution Module with a single wire pair. Wire pairs shall be shielded if near any power runs, otherwise standard pair is acceptable. Wiring shall be RATH® Custom Communication Cable (part # RP7500094). If CI 2 hour fire-rated cable is required, use RATH® Communication Cable (part # RP6600300M). For a UL Listed option use part # RPP66010002.

E. System shall be in compliance with all state and local electrical codes.

F. The system shall be monitored by the building fire alarm system per NFPA 72 using RATH® Supervisor Board 2500-XXSPVSR.

3.2 CABLING

A. Cabling for two-way communication system shall meet the applicable requirements for pathway survivability. Cabling installation shall consist of one or more of the following:

B. 2 hour fire-rated circuit integrity (CI) cable – RATH® part # RP6600300M (for a UL Listed option use part # RPP66010002).

C. 2 hour fire-rated cable system.

D. 2 hour fire-rated enclosure or protected area.

3.3 COMMUNICATIONS

A. The Call Boxes shall be an ADA compliant and vandal resistant speakerphone.

B. The Call Boxes shall be hands-free and be a push-button-once to talk system. Once the button has been pushed, the Call Box will call the Base Station. If no answer at the Base Station, it will automatically call a pre-programmed emergency number. The Call Box must be capable of being programmed with up to 2 emergency numbers (either both off-site or Base Station and one off-site).

C. The Call Box shall have location message capability. Call Box must have a minimum 18 second recordable message capability, programmable to play 1 or 2 times. Call Box shall notify called party of the location of the call upon being received at the emergency dispatch center.

D. The Call Box shall be capable of allowing the called party to replay the location message if necessary to ensure an understanding of the caller location.

E. If system is not attended to 24 hours a day, the Call Box must dial a secondary location outside the building to activate two-way off-site person to person voice communications.

F. Once a call has been made (button pushed), the call can only be terminated by the called party.

G. The Call Box must have a red LED that will light up upon push of the button. The light shall be a solid color when the Call Box is activated and will flash when call has been answered.

H. The Call Box must be capable of being programmed and re-programmed on-site.

I. Standard Call Box features:

1. Two number programming (either both off-site or Base Station and one off-site).

2. Operating temperature of between -40˚F to +150˚F (-40˚ to + 65˚ C).

3. On-site programmable.

4. EEPROM memory to protect programming

3.4 SIGNAGE

A. System shall consist of a minimum of one 120/277vac edge light sign (part # 7050 or 7050E), a “location” and “instruction” sign (part # 7049SS) to clearly indicate location of designated area. A tactile sign (part # 7043/7044 or 7087) with raised letter and Braille shall be located at entrance to area.

3.5 GRAPHICS

A. Command Center must include wording identifying the location of each Call Box and light an LED when a particular Call Box has been activated.

B. The Call Box wording must include “Emergency Phone”, International Phone Symbol and raised Braille lettering.

3.6 WARRANTY

A. The Command Center and Call Boxes shall be warranted for a period of three years.

3.7 MANUFACTURER

The manufacturer shall be:
RATH® Communications
N56 W24720 North Corporate Circle
Sussex, WI 53089
800-451-1460
Website: www.rathcommunications.com

PART 1 - GENERAL

1.1 SPECIFICATIONS SHOW INFORMATION FOR BOTH BASE BID AND FOR ADDITIVE BID ALTERNATE #2:

a. BASE BID: FURNISH AND INSTALL ALL AUDIOVISUAL BACKBOXES, PATHWAY, PULLSTRING, SUPPORTS/INFRASTRUCTURE AND CERTAIN AUDIOVISUAL DEVICES WHERE EXPLICITLY INDICATED ON PLANS AND SPECIFICATIONS.

b. ADDITIVE BID ALTERNATE 2 : FURNISH, INSTALL AND COMMISSION ALL AUDIOVISUAL DEVICES AND CABLING.

1.2 SECTION INCLUDES

A. Provide all labor, materials, transportation and equipment to complete the furnishing, installation, assembly, set up, and testing of the Sound and Audiovisual System work indicated on the drawings and specified herein. **Notwithstanding any detailed information in this Section, including Bid/Bid Alternate Scope separation as described in 1.1, above, provide complete, working systems.**

B. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Work of this Section. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.

1.3 SYSTEM FUNCTIONS

A. Provide the following, in addition to work shown on the drawings and specified in Parts 2 and 3 below:

B. Loudspeaker/Audio Processing, general

1. Program audio and speech content to output through overhead loudspeakers.

C. Racking compartment, general

1. Provide blank plates at all unused openings.

2. Provide fans as required to keep the interior of each equipment rack at a temperature of at least 5-10 degrees cooler than equipment manufacturer's recommended operating temperature.

a. Fans to not emit more noise than 30 dB.

D. Controls Systems, general

1. Review all push button and touchpanel button nomenclature with College's Representative prior to system programming.

2. Provide graphic indication of program volume level on control touchpanel when volume control is selected.

3. Provide Main menu selection button on all touchpanel screens to route user back to main touchpanel menu.

E. Control Functions

1. Control: Confirm all control functions and layouts with College's Representative prior to system programming.

2. Wall Control:

a. General: Functions to operate by scene/mode, not by device.
   1) End user selection of a single A/V input source (push buttons) automates:
      a) Projection screens lower
      b) Projectors turn on
      c) Presets recalled
      d) Sets audio chain to loudspeakers
   2) End user selection on an Audio Only input automates:
      a) Sets audio chain
   3) Control Push Button Selections
      a) Audio Mute
      b) Video Mute
      c) Program Volume
      d) Power Off
   4) Touchpanel Menus
      a) Startup Page: “Press here to begin”
      b) Home Page:
      c) “Select Source”: Provides sub-menus of source selections:
         1. PC, where occurs
         2. Laptop HDMI
         3. AUX HDMI, where occurs
         4. Mini Stereo audio only
      d) “Controls”: Provide sub-menu of:
         1. Screen up/down control
         2. Individual projector on/off control
      e) “Power Off”: Provides sub-menu selection of “Do you want to power off the system?” with “Yes” and “No” selections. Upon selection of “Yes”, menu reads “Please wait, shutting down system”
      f) All menus, except Home Page, to include “Home” button to revert back to the Home Page.

1.4 REFERENCE STANDARDS

A. Conform to the applicable portions of the current standards published by these organizations:
   1. SMPTE Society of Motion Picture and Television Engineers.
   2. NAB National Association of Broadcasters.

3. EIA Electrical Industries Association of America.
4. UL Underwriters Laboratories.
5. AES Audio Engineering Society.
6. NEC National Electrical Code.
7. UBC Uniform Building Code.
8. NFPA National Fire Protection Association.
9. EIAJ Electrical Industries Association of Japan.
10. IEC International Electrotechnical Commission.
11. FCC Federal Communications Commission.
12. NTC Network Transmission Committee of the Video Transmission Engineering Advisory Committee.
13. NCTA National Cable Television Association.
14. BTSC Broadcast Television Stereo Committee.
15. TASO Television Allocation Study Organization.

B. Conform additionally to the following specific standards:

1. American National Standards Institute (ANSI)
   a. ANSI S1.4-1983 (R2001) American National Standard Specification for Sound Level Meters
   b. ANSI S1.11-1986 (R2001) American National Standard Specification for Octave-Band and Fractional Octave-Band Analog and Digital Filters
   c. ANSI S1.42-1986 (R2001) American National Standard Design Response of Weighting Networks for Acoustical Measurements
   d. ANSI IT 7.214-89 Audio-visual Systems - Front Projection Screens (Tripod/Free-Standing) - Methods for Testing and Reporting Performance Characteristics.

2. Audio Engineering Society Incorporated (AES)
   a. AES2-1984 (r1997) AES recommended Practice Specification of Loudspeaker Components Used in Professional Audio and Sound Reinforcement
   b. AES5-1998 (Revision of AES5-1984) AES recommended practice for professional digital audio – Preferred sampling frequencies for applications employing pulse-code modulation
   c. AES14-1992 (r1998) AES standard for professional audio equipment – Application of connectors, part 1, XLR-type polarity and gender
   d. AES20-1996 AES recommended practice for professional audio – Subjective evaluation of loudspeakers
   e. AES26-2001 Revision of AES26-1995 AES recommended practice for professional audio interconnections – Conservation of the polarity of audio signals
   f. AES-R2-1998 AES Project Report for articles on professional audio and for equipment specifications – Notations for expressing levels

3. Electronic Industries Association of America (EIA)
   a. EIA-160 Sound Systems
   b. EIA-310-E Racks, Panels and Associated Equipment
   c. EIA-101-A Amplifiers for Sound Equipment
   d. SE-103 Speakers for Sound Equipment
   e. SE-104 Engineering Specifications for Amplifiers for Sound Equipment

4. International Electrotechnical Commission (IEC)
   a. IEC 268-3 (1988) Sound system equipment – Part 3: Amplifiers
   b. IEC 268-5 (1989) Sound system equipment – Part 5: Loudspeakers
   c. IEC 268-12 (1987) Sound system equipment – Part 12: Application of Connectors for Broadcast and Similar Use
   d. IEC 651 (1979) Sound level meters

5. International Organization for Standardization (ISO)
   a. ISO 1996-1 Acoustics – Description and measurement of environmental noise – Part 1: Basic quantities and – Composite Analog Video Signal – NTSC for Studio Applications

6. Federal Specifications (FS)
   a. GG-S-00172D Screen, Projection. Federal Supply Classification (FSC) 670.

7. Federal Standards (Fed-Std)
   a. 191A Textile Test Methods.
      1) 5760 Mildew Resistance of Textile Materials; Mixed Culture Method.
      2) 5903.1 Flame Resistance of Cloth; Vertical.

8. NFPA
   a. 255 Method of Testing Surface Burning Characteristics of Building Materials.
   b. 701 Methods of Fire Tests for Flame-Resistant Textiles and Films.

9. Society of Motion Picture Engineers (SMPTE).
   a. SMPTE 196M-86 Motion Picture - Screen Luminance and Viewing Conditions - Indoor Theater Projection Guide.
   b. SMPTE 202M-1998 Motion Pictures – B Chain Electroacoustic Response – Dubbing Theaters, Review Rooms and Indoor Theaters
   c. SMPTE RP167-1995 Alignment of NTSC Color Picture Monitors
   d. SMPTE EG1-1990 Alignment Color Bar Test Signal for Television Picture Monitors
   e. SMPTE EG27-1994 Supplemental Information for ANSI/SMPTE 170M and Background on the Development of NTSC Color Standards (R1999)
   f. RP 94 Recommended Practice for Gain Determination of Front Projection Screens.
   g. SMPTE RP 95 Recommended Practice for Installation of Gain Screens.
   h. SMPTE RP 98 Recommended Practice for Measurement of Screen Luminance in Theatres.

10. Underwriters Laboratories Incorporated (UL)
    a. UL 813 Commercial Audio Equipment 1996
    b. UL 1419 Professional Video and Audio Equipment 1997
    c. UL 1492 Audio-Video products and Accessories 1996
    d. UL 6500 Audio/Video and Musical Instrument Apparatus for Household, Commercial and Similar General Use 1999

1.5 RELATED WORK IN OTHER SECTIONS

A. Division 26 – Power for all equipment
B. Section 27 05 00 – Common Work Results for Communications Systems
C. Section 27 05 26 – Grounding and Bonding for Communications Systems

D. Section 27 05 29 – Hangers and Supports for Communications Systems
E. Section 27 05 33 – Conduits and Backboxes for Communications Systems
F. Section 27 05 36 – Cable Trays for Communications Systems
G. Section 27 05 43 – Underground Duct and Raceways for Communications Systems
H. Section 27 05 48 – Noise and Vibration Control for Communications Systems
I. Section 27 05 53 – Identification for Communications Systems
J. Section 27 10 00 – Structured Cabling for Communications Systems
K. Section 27 11 16 – Communications Racks, Frames and Enclosures
L. Section 27 11 19 – Communication Termination Blocks and Patch Panels
M. Section 27 11 23 – Communications Cable Management
N. Section 27 13 00 – Communications Indoor Backbone Cabling
O. Section 27 14 00 – Communications Outside Plant Backbone Cabling
P. Section 27 15 00 – Communications Horizontal Cabling

1.6 QUALITY ASSURANCE

A. Test Equipment. Provide in conformance with the applicable requirements of Section 27 05 00 – Common Work Results for Audiovisual Systems. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:

1. Sound Systems:
   a. Wide band oscilloscope, 50 MHz analog. (Example: NTI Audio Minilyzer ML1).
   b. True RMS audio digital volt-ohm-millimeter (Example: Fluke 8060A).
   c. Integrated audio test set (Example: Audio Precision or NTI Audio Minilyzer ML1).
   d. Acoustic polarity tester (Example: NTI Audio Minilyzer ML1).
   e. Pink Noise generator (Example: NTI Audio Digital Audio Signal Generator, Extron VTG 300R).
   f. Calibrated microphone and pre-amplifier assembly (Example: 1/2” ANSI Type 1 ACCO, Larson Davis, Bruel & Kjaer free field incidence capsule, preamplifier/power supply).
   g. Real time audio spectrum analyzer, one-third octave (Example: NTI Audio Acoustilyzer AL1 or Minilyzer ML1, Ivie IE-30A or Rational Acoustics Smaart system).
   h. Frequency/time audio analyzer (Example: Goldline TEF system or Rational Acoustics Smaart system).

2. Baseband Video Systems:
   a. Wide band oscilloscope, 50 MHz, analog. (Example: Tektronix TDS3000C).
   b. Analog composite test generator (Example: Tektronix SPG300).
   c. Analog composite waveform/vector monitor (Example: Tektronix WFM series.)

3. RGBHV Wideband Component Analog Video Systems:
   a. Wide band oscilloscope, 500 MHz, analog. (Example: Tektronix TDS3000C).
   b. RGBHV test generator (Dot clock 200 MHz, Pixel clock accuracy 100 ppm, Horizontal frequency range 15 kHz to 131 kHz, Vertical frequency range 20 Hz to 120 Hz. (Example: Extron VTG 400D).

4. HD/SDI Video Systems

a. Pattern & Test Signal Generator (Example: Extron VTG 400D, Tektronix SPG300).
b. Portable Waveform Monitor/Rasterizer (Examples: Tektronix WFM series, Leader LV5750 with HD/SDI Options)

5. HDMI Video Systems
   a. HDMI EDID Diagnostic (Example: Kramer VA-2H).

6. Projection Systems:
   a. Luminance meter. (Example: Tektronix J17/J18 with J1803 8 degree luminance head.).
   b. Grey scale chart.
   c. Precision optical comparator. (Example: Phillips or Tektronix J17/J18 with J1810/J1820 chromaticity head.).

7. Structured Cabling used for Audiovisual Systems
   a. Level III field testers as defined in ANSI/TIA-1152 - Fluke, Agilent Or approved equal.
      1) The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of ANSI/TIA-1152
      2) The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
      3) The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The Contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
   b. Tone Test Sets.

8. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

1.7 SUBMITTALS

A. Conform with Section 27 05 00 - Common Work Results for Communications Systems

1.8 CONFLICTS

A. Present any conflicts between codes, regulations, specifications and/or requirements at least thirty (30) calendar days prior to the commencement of the scheduled work.

1.9 SYSTEM PERFORMANCE REQUIREMENTS, AUDIO-VISUAL SYSTEM

A. Using the listed test equipment, document that the installed systems meet or exceed the performance standards below.
   1. Audio Playback and Sound Reinforcement Systems:
      a. Electrical Performance; Source Input to Power Amplifier Output:
         1) Frequency Response (Equalizer flat): +0.5 dB 30 Hz to 15 kHz.
         2) Total Harmonic Distortion (THD): Less than 0.5%, 30 Hz to 15 kHz, +4 dBm line level.
         3) Signal to Noise: At least 70 dB, 30 Hz to 15 kHz, referenced to input of +4 dBm.
         4) Crosstalk: At least -60 dB, 30 Hz to 15 kHz.
      b. Electro/Acoustic Performance:
         1) Standard Classrooms, Coaching Spaces and Conference Rooms
            a) Uniformity of Coverage:
               (a) Consistent with installed device, location in room and geometric dispersion of sound level.
            b) Minimum Sound Pressure Level, Pink Noise Input measured on axis to device under test, center of room, at 4 feet above the floor using a freestanding Type 1, microphone:
               (b) Program Audio 80 dB flat weighting, in each octave from 125 Hz to 8 kHz, without clipping.
      c. Equipment: Specified individually.
      d. Audio Signal Path: Shall not degrade performance of connected equipment.
   2. Video Systems
      a. Digital performance concurrent with SMPTE 292M HDTV requirements at 1.5 Gigabits.
      b. Analog Composite Video Frequency Response: 100 KHz to 20 MHz within 0.5 dB
      c. Analog Component/RGBHV Video Frequency Response: 100 KHz to 350 MHz within 3.0 dB
      d. Analog NTSC Video Signal to Noise Ratio: at least 65 dB.
      e. Analog RGBHV Video Signal to Noise Ratio: at least 58 dB.
      f. Analog Video Differential Phase and Gain: no more than 0.5 degrees and 0.5 percent, respectively.
      g. Analog and Digital Video Signal to Crosstalk Ratio: at least 50 dB.
      h. Analog Video Timing; no more than .25 degrees variation at 3.58 MHz between any two parallel lines to the same location.
   3. Projection Systems:
      a. Consistent with performance of specified projectors and screens.
      b. Brightness, convergence per ANSI standard procedures for device.

B. System Gain/Levels
   1. Maintain consistent signal levels throughout the Project for each type of signal carried. Patch points shall be unity gain, "flat" equalization, unless specifically noted otherwise herein or on the drawings. The reference signal levels shall be;
      a. Analog Video; 1.0 Volt peak to peak composite signal, sync tip to peak white, defined as "100 IRE", or "100% signal".
      b. TV RF; 1000 microVolts, defined as "0 dBmV"
      c. Digital Audio, Line Level; -20 dbfs, defined as "0 VU"
      d. Analog Audio, Line Level; +4 dBu, defined as "0 VU"

e. Analog Audio, Microphone Level; -50 dBm, 150 ohms
f. Analog Audio, Speaker Level; Greater than +20 dBm
g. Data and Control; As defined by the specification for the signal carried, e.g., RS-232, RS-422 or any other such appropriate standard

C. Masking
1. Masking sound level, following Contractor's level and signal equalization

2.

1/3 Octave Band	Sound Pressure Level and maximum permitted variance (dB) below ceiling tile
50 Hz:	47.0 (+4/-6) dB
63 Hz:	47.0 (+4/-5) dB
80 Hz:	47.0 (± 4) dB
100 Hz:	47.0 (± 3) dB
125 Hz:	47.0 (± 3) dB
160 Hz:	46.0 (± 3) dB
200 Hz:	45.0 (± 2) dB
250 Hz:	44.0 (± 2) dB
315 Hz:	42.7 (± 2) dB
400 Hz:	41.3 (± 2) dB
500 Hz:	40.0 (± 2) dB
630 Hz:	38.3 (± 2) dB
800 Hz:	36.7 (± 2) dB
1000 Hz:	35.0 (± 2) dB
1250 Hz:	33.3 (± 2) dB
1600 Hz:	31.7 (± 2) dB
2000 Hz:	30.0 (± 2) dB
2500 Hz:	28.3 (± 2) dB
3150 Hz:	26.7 (± 2) dB
4000 Hz:	25.0 (± 2) dB
5000 Hz:	22.3 (± 2) dB
6300 Hz:	19.7 (± 3) dB
8000 Hz:	17.0 (± 4) dB
10,000 Hz:	12.0 (+4/-6) dB

D. Measurements

1. Contractor to submit quantitative test reports substantiating conformance with the technical performance standards outlined herein above for each cable run, component, subsystem and overall system installed under the work of this Section, concurrent with or prior to identifying to the College's Representative that the work is Substantially Complete.

2. Conform with the requirements of Section 27 05 00 – Common Work Results for Audiovisual Systems as to means and method of submittal.

1.10 TRAINING

A. Conduct training on completed system at reasonable convenience of the College during normal business hours.

1. Operator Training: 8 hours, including classroom format and hands-on training. Document training using the systems installed under the work of this project. Transmit a copy of the training recordings to the College on DVD for subsequent retraining and reference by College staff.

2. Initial Use Support: Provide standby trainer/system engineer during one (2) system uses, not to exceed 8 hours of supplemental support training.

1.11 DEFINITIONS

A. Definitions of Terms: The following definitions and conditions apply to each of the respective parameters and the measurements of those parameters, unless specifically stated otherwise:

1. Frequency Response: The minimum acceptable frequency band over which the amplitude response is within 3 dB (or any specified range), or the specified limits of the response relative to the reference frequency (1 kHz for audio, 1.0 MHz for video) under design load conditions, at any operating level up to and including the specified maximum output while fully in compliance with all other performance specifications.

2. Maximum Output Level: The minimum acceptable maximum signal output level (voltage, current or power) attained under design load conditions attained while fully in compliance with all other performance specifications.

3. Harmonic Distortion: The maximum acceptable harmonic distortion measured at any operating level, up to and including the specified maximum output, with an applied sine wave signal of any frequency in the range of the specified frequency response.

4. Audio Intermodulation Distortion: The maximum acceptable intermodulation distortion resulting from the introduction of 60 Hz and 7 kHz signals in a ratio of 4:1 under design load conditions at any operating level up to and including the specified maximum output level.

5. Signal to Noise Ratio: The minimum acceptable ratio of signal to noise levels derived from broadband measurements under design load at maximum output over the entire range of the specified frequency response.

6. Clipping Level: The minimum acceptable maximum level of signal applied to the device under design load conditions while fully in compliance with all other performance specifications.

7. Sensitivity: The maximum acceptable level of input signal applied to the device that is necessary to provide the maximum output under design load conditions.

8. Design Load: The load (in ohms) specified by usage of the particular device input or output.

9. Composite Triple Beat Ratio: The ratio of visual carrier level to composite third order distortion products.

10. Cross Modulation Ratio: The ratio of visual carrier level to coherent spurious signal level (i.e. intermodulation products).

11. Carrier to Noise Ratio: The ratio of visual carrier to noise levels derived from broadband measurements under design load at maximum output over the entire range of the specified frequency response.

B. Signal Levels: The following voltage levels shall be considered the standard operating levels for the particular circuitry, unless specifically noted otherwise (0.775 Volt = 0 dBu = 0 dbm for a 600 ohms terminated circuit):

1. Microphone Circuits: -30 dBu or less.

2. Audio Line Level Circuits: -30 dBu to +24 dBu; equivalent to -30 dBm to +24 dBm for a 600 ohms terminated circuit.

3. Loudspeaker Level Circuits: More than +24 dBu.

4. Video Line Level Circuits: 1.0 Volt, peak to peak composite signal.

5. Radio Frequency (RF), Television (MATV) Circuits: +6 to +72 dBmV (0 dBmV = 1,000 microvolts).

C. Characteristic Impedances: The following operating impedances shall be considered to be the standard operating impedances for the particular circuitry, unless specifically noted otherwise:

1. Microphone Circuits: 50-250 ohms source, 150-1500 ohms terminating, electrostatically and electromagnetically balanced to ground.

2. Audio Line Level Circuits: 600 ohms maximum source, 600 ohms minimum terminating, line to line, electrostatically and electromagnetically balanced to ground.

3. Video Line Level Circuits: 75 ohms maximum source, 75 ohms minimum terminating to shield and signal ground, with Vertical Standing Wave Ratio (VSWR) not to exceed 1.2.

4. Radio Frequency (RF) Television Circuits: 75 ohms nominal to shield and signal ground, with Vertical Standing Wave Ratio (VSWR) not to exceed 1.2.

1.12 SOFTWARE LICENSING

A. Provide licensing for Project-specific software programming at programmable devices.

B. Provide licensing and original software copies for each device provided under Work of this Section that uses software for operation, configuration or control.

1. Provide licensing for required workstation operating systems, and required third party software.

2. For the Control System, provide a complete copy of the source code, including the device interface driver code modules.

C. Upgrade each software package to the release in effect at the end of the Warranty Period.

PART 2 - PRODUCTS

2.1 LOUDSPEAKER ASSEMBLIES AND RELATED **(BASE BID)**

A. Compact Package Full-Range Loudspeakers Speakers, Wall-mount
1. Drawing Reference: SR
2. Manufacturers:
a. Extron SM-3 (District Standard, no substitution)

B. Compact Full-Range 70v Loudspeaker, Ceiling
1. Drawing Reference: SA
2. Manufacturer:
a. Extron CS-3T w/ Speedmount Enclosure where required for installation in suspended ceilings. (District Standard, no substitution)

C. Full-Range 70v Loudspeaker, Pendant
1. Drawing Reference: SP
2. Manufacturer:
a. Extron Soundfield 3” Full-Range Pendant Speaker, White (District Standard, no substitution)

2.2 GENERAL POWER AMPLIFIERS AND RELATED

A. Power Amplifiers, General

1. Drawing Symbol: PA[number].

2. Provide the following functions and/or features

a. Employ solid state devices (integrated circuits and/or transistors) throughout and employ positive protection of circuit components.

b. With amplifier input driven 10 dB beyond input level required to produce full rated output, amplifier shall withstand for at least 15 seconds any of the following load conditions without instability or operation of main over current protection (i.e. no blown fuses or circuit breakers).
1) "Short" circuit of 0.1 ohm.
2) Open circuit (no load).

3) Standard Reactive Load: 5.4 ohms in series with the parallel combination of 12.5 microhenrys; 800 microfarads and 18.3 ohms resistive.

c. Peak voltage of turn-on and/or turn-off transients not greater than 20 dB below maximum rated amplifier output.
1) Time duration of transients not to exceed 3 seconds.

d. Input level controls for each output channel to be calibrated, stepped attenuators with at least 50 dB range.
1) For 0 to 34 dB of attenuation, steps not to be greater than 2.0 dB.
2) Attenuators to track calibration within 0.5 dB.
3) Stepped attenuators are not required at Power Amplifiers where the connected driving source device includes a precision attenuator under digital control with precision not less than that specified herein.

e. Input Connectors: XLR connector or tip sleeve (standard) phone jack or barrier strip.

f. Output Connectors: Standard 0.75 inch spacing "5-way" binding posts, or barrier strip.

g. Where integral cooling fans are provided, such fans shall have a minimum life rating of 50,000 hours at 25 degree Centigrade ambient temperature.

h. Where indicated, provide balanced input, differential or transformer. Provide matching accessory to implement if not a standard feature of the product provided.

i. Listed by a Nationally Recognized Testing Laboratory.

3. Minimum performance requirements with all channels driven

a. Power Output Per Channel: As scheduled on Drawings as Minimum Amplifier (Min Amp) and specified below; continuous average sine wave power into 70 Volt line over a bandwidth of 40 Hz to 20 kHz.
1) Frequency Response: plus 0 dB, minus 0.5 dB, 40 Hz to 20 kHz at rated output.
2) Total Harmonic Distortion: Less than 0.25 percent at rated output, 40 Hz to 20 kHz.
3) Intermodulation Distortion: Less than 0.04 percent at rated output using frequencies of 60 Hz and 7 kHz, mixed in a ratio of 4:1.
4) Input Impedance: 15,000 ohms minimum; unbalanced, or balanced as shown on drawings.
5) Hum & Noise: At least 94 dB signal-to-noise ratio.
6) Channel Separation: At least 75 dB at 1 kHz.
7) Phase Shift: Less than plus20 degrees from 20 Hz to 20 kHz.
8) D.C. Offset: Less than 10 millivolts.

B. Power Amplifiers, Mono, 70 Volt **(BASE BID)**

1. Drawing Symbol
a. PA70-200
2. Manufacturer

a. Extron XPA 2001-70V (District Standard, no substitution)

C. Power Amplifiers, 2 Channel, Low Impedance **(BASE BID)**
1. Drawing Symbols: PA30
2. Comply with Power Amplifiers, General, in this Section.
3. Power Output Per Channel, continuous average sine wave power into 8 ohm voice coil impedance, not less than 30 Watts
4. Manufacturer, PA30
   a. Extron MPA 152 Plus (District Standard, no substitution)

D. Sound Bar Speaker **(ADDITIVE BID ALT. #2)**

1. Drawing Reference: SBS
2. Construction:
   a. System Configuration 2-channel 2-way full-range for music / speech
   b. Components & Loading (2) 3.5 ” long-throw woofers and (1) 0.75“ tweeter per channel
   c. Recommended High-Pass Filter On-board 1st order @ 120 Hz; no outboard HP needed
   d. Enclosure Type Low profile sealed enclosure
   e. Enclosure Material Extruded ABS plastic with steel baffle insert
   f. Finish: Black
   g. Connectors Dual binding-head screws
   h. Suspension Hardware Universal mounting kit for direct attachment to display
   i. Grille Integral fabric wrap
3. Minimum Features/Function/Performance:
   a. Frequency Response: 120 – 20,000 Hz, +/- 3 dB
   b. Sensitivity 90 dB @ 2.83 volts / 1M
   c. Impedance 8 ohm
   d. Power Handling 90 W long term (AES-2) (per channel)
   e. Maximum Output 103 dB long term; 109 dB peak
   f. Nominal Coverage Angles 100□ H x 120□ V
   g. Nominal Dimensions
      1) height: 4.13 “
      2) width: match display wall
      3) depth: 2.06 ”
   h. Net Weight 15 lbs
4. Manufacturers:
   a. Innovox FS-H2
   b. Cambridge Sound

c. Or equal.

E. Paging Horn - 70V Coupled, Wall Mount, Weather Resistant **(BASE BID)**

1. Drawing Reference: SHC4
2. Complete Assembly to consist of:
   a. Constant directivity horn consisting of a 1.5” voice coil.
   b. Seventy volt tap transformer; 30 W minimum tap.
   c. Frequency Range (+/- 5dB): 400 Hz – 6.5 kHz.
   d. Sensitivity: 107 dB @ 1W/1m.
   e. Coverage: 60 degrees horizontal, 40 degrees vertical
   f. Weather resistant enclosure.
   g. Nominal Dimensions: 9”H x 12”W x 14”D.
   h. Tilting wall mount bracket.
   i. Finish: Per Architect.
3. Manufacturer
   a. ElectroVoice PA430T
   b. Community
   c. Atlas Sound
   d. Or equal

2.3 ASSISTIVE LISTENING SYSTEM (ALS):

A. General
1. Provide Radio Frequency Type, Frequency Modulated
2. 72 MHz Assistive Listening band.
3. Quantity of Devices: refer to ALS schedule on TA-001.

B. ALS Transmitter **(ADDITIVE BID ALT. #2)**
1. Drawing Symbol: ALS TX
2. Manufacturer
   a. Listen Technologies LT-700-072 (District Standard, no substitutions)

C. Receivers and Accessories **(ADDITIVE BID ALT. #2)**
1. Receiver
   a. Battery powered, rechargeable.
   b. Volume control.
   c. Receptacle for earphone/accessory.
   d. Rechargeable battery.
   e. Tunable to channel in use by the user.
   f. Quantity: As Scheduled on the plans
2. Earphone

a. Ear hung, not inserted in the ear canal.
b. Hearing-Aid Compatible - For hearing-aid compatible receivers:
c. Wireless neck loop compatible with “T” coil hearing aids.
d. Built-in antenna
e. Operates with provided receivers

3. Manufacturer
   a. Listen Technologies LR-500-072-0-M-C, LA-164 earphones, and LA-166 neck loops (Compatible with District Standard ALS Transmitter, no substitutions)

D. Battery Charger/Storage/Carry Case
1. Features
   a. Store and charge up to 16 Receivers and related accessories.
   b. Cover, latches and carrying handles.
   c. Removable lid.
2. Quantity: To simultaneously recharge each receiver as scheduled on the plans
3. Manufacturer
   a. Listen Technologies LA-325 (Compatible with District Standard ALS Transmitter, no substitutions)

2.4 CONTROL SYSTEM, SWITCHING AND RELATED

A. General

1. Products provide under this Section shall be made by manufacturers regularly engaged in the production of programmable commercial audio-visual control systems. Such manufacturers shall have at least 5 years prior production experience in the manufacture of such goods.

2. Provide control system to perform functions scheduled on drawings and herein.

   a. System to be field programmable.

   b. Provide programming allowance to implement system as required to provide the functionality indicated herein and as defined by the College during design and construction phase meetings, including closely matching the user interface of the existing control panels used elsewhere at the College in style, color and organization to the extent directed by the College’s Representative.

3. In addition to providing programming to meet the requirements outlined in part one of this specification section and as outlined by the College during the preconstruction programming meetings, Contractor to provide an allowance of up to $2000 to implement new functions in the audiovisual systems programming identified by the College after the substantial completion of this project. Allowance may not be expended by the Contractor in completing the base bid scope of work including Warranty defect items.

B. Control Processor **(ADDITIVE BID ALT. #2)**
1. Drawing References: CONTROL (Conference/Group Study)
2. Manufacturers:
   a. Extron IPCP Pro 250 (compatible with District Standard, no substitution)

C. Control Panels, Touch, 7" Diagonal **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: CTP (table-top), CTW (wall)
   2. Manufacturers
      a. Extron TLP Pro 725M & XTP PI 100 (District Standard, no substitution)

D. 100 Base-T Control LAN Ethernet Switch **(ADDITIVE BID ALT. #2)**
   1. Drawing References: NSW/NSW24
   2. Port Count:
      a. As Required plus at least 3 spare
   3. Features/Functions/Performance:
      a. RJ-45 10/100Base-TX ports (IEEE 802.3 Type 10Base-T; 802.3u Type 100Base-TX) ports.
      b. Each port can automatically provide 10 or 100 MBps Ethernet Layer 2 switching.
      c. Each port can automatically sense maximum connection speed of attached device (10 or 100 MBps) and its ability to support full or half duplex connectivity and respond (auto-sensing). .
      d. Performance - at least:
         1) throughput: 1 million pps (64-byte packets)
         2) address table size: 2,000 entries
      e. Communications - provides full support for the following standards:
         1) IEEE 802.1p Priority;
         2) IEEE 802.1D Spanning Tree;
         3) IEEE 802.1Q VLANs;
         4) IEEE 802.3x Flow Control
      f. Management - Provide at least:
         1) SNMPv1/v2c
      g. Environmental - can operate normally within at the following range of conditions:
         1) operating temperature: 0 degrees C to 55 degrees C (32 degrees F to 131 degrees F)
         2) relative humidity: 15 to 95% @ 40 degrees C (104 degrees F), non-condensing
      h. Provides port filtering by MAC address.
      i. Automatic shutdown of ports detecting jabber
      j. Status lights indicating at least port activity on each port.
   4. Construction.
      a. 1 Rack Unit maximum per 12 ports provided.
      b. Provide accessories as required to rack mount.
   5. Manufacturers:
      a. Netgear
      b. DLink
      c. Hewlett Packard
      d. Cisco Systems
      e. Or approved equal.

E. Modular Control Panel **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: CBP
   2. Manufacturer:

a. Extron MLC Plus 200 (District Standard, no substitutions)

2.5 VIDEO PROCESSING

A. Digital Presentation Switcher (Classroom)
1. Drawing Reference: AVSW1 **(ADDITIVE BID ALT. #2)**
2. Manufacturer:
a. Extron IN1808 (District Standard, no substitution)

B. Digital Presentation Switcher (Conference/Group Study)
1. Drawing Reference: AVSW2 **(ADDITIVE BID ALT. #2)**
2. Manufacturer:
a. Extron 1N1604 DTP (compatible with District Standard, no substitution)

2.6 NOTIFICATION SYSTEM

A. 2-WAY NOTIFICATION SYSTEM LOUDSPEAKER **(ADDITIVE BID ALT. #2)**
1. Drawing Reference: NS
2. Features/Functions:
a. IP flush mount loudspeaker w/ powder-coated metal grille.
b. 12”W x 12”H x 4”D
c. 8” High efficiency PA speaker
d. Built-in Sound Masking
e. Built-in Microphone for 2-way communication
f. Manufacturer’s back-box included
3. Manufacturer:
a. Advanced Network Systems IPSWS-FM
b. Or equal.

B. PUSH-TO-TALK 2-WAY NOTIFICATION SYSTEM **(ADDITIVE BID ALT. #2)**
1. Drawing Reference: PTT
2. Features/Functions:
a. Faceplate dimensions 4.5”H x 2.75” W for installation with any standard single-gang junction box.
b. Includes call button, faceplate (16 ga. Polished stainless steel), vandal resistant screws and peripheral interface adaptor board.
3. Manufacturer:
a. Advanced Network Systems AND-BTN-KIT-1.
b. Or equal.

2.7 SOURCE DEVICES

A. USB Pan-Tilt-Zoom Camera (Communications Lab) **(ADDITIVE BID ALT. #2)**

1. Drawing Reference: PTZ
2. Manufacturer:
a. Huddly IQ
b. Or equal

B. Wireless Connection Gateway **(ADDITIVE BID ALT. #2)**

1. Drawing Reference: WCG

2. Features/Functions:
   a. Number/signal type/connectors
      1) 1 HDMI digital video
      2) 1 female HDMI type A
   b. Horizontal frequency 15 kHz to 100 kHz
   c. Vertical frequency 24 Hz to 75 Hz
   d. Resolution range (Window mode) 640x480 @ 60 Hz to 1920x1200 @ 60 Hz (includes 480p, 576p, 720p, 1080p)
   e. Resolution range (Pass-through mode) 640x480 @ 60 Hz to 4096x2160 @ 60 Hz (includes 480i, 480p, 576i, 576p, 720i, 720p, 1080i, 1080p, 2K, 4K)
   f. Standards DVI 1.0, HDMI 2.0, HDCP 2.3
3. Manufacturer:
   a. Extron Sharelink Pro 500
   b. Or equal

C. Conference Camera/Microphone/Soundbar Speaker Hub **(ADDITIVE BID ALT. #2)**

1. Drawing Reference: HUB
2. Features/Functions:
   a. 20MP 1-inch CMOS Camera
      1) 60fps max
      2) 133-degree field of view
   b. Microphone Array
      1) Built-in 8 MEMS
      2) Beamforming and Noise-suppression
      3) Full-duplex
      4) Echo-cancellation
   c. Speaker
   d. Build-in 5W Loudspeaker
3. Connectivity
   a. USB, 1x USB 3.0, 1x USB 2.0
   b. Audio 1x 3.5mm audio line in
4. Power: DC 48V/0.7A
5. Manufacturer:
   a. Yealink UVC40
   b. Crestron
   c. Or equal

D. Multi-Port USB Hub (Communications Lab) **(ADDITIVE BID ALT. #2)**
1. Drawing Reference: USB-HUB
2. Manufacturer:
   a. Netlink
   b. Lenovo
   c. Or equal

E. Handheld Wireless USB Microphone (Communications Lab) **(ADDITIVE BID ALT. #2)**
1. Drawing Reference: HMR
2. Manufacturer:
   a. Samson Stage XPD2 Handheld Digital Wireless System

b. Shure
c. Or equal.

F. Ceiling Microphone System and Processor **(ADDITIVE BID ALT. #2)**
1. Drawing Reference: CMIC, CM, CMIC-PROC
2. Features:
   a. Dante interface with (2) RJ-45 sockets
   b. Audio Analog Out, 3-pin Phoenix Connector
   c. PoE via RJ-45 Socket
   d. Configuration via software or media control system
3. Manufacturer:
   a. Sennheiser Team Connect 2 w/ ceiling mounting frame for lay-in ceilings or ceiling suspension set for open/hard ceiling conditions
   b. Or equal

G. Radio Frequency Receiver/Wireless Microphone System: **(ADDITIVE BID ALT. #2)**
1. Drawing Reference(s): W, WMIC, WMIC REC
2. Provide quantity of complete systems to match quantity indicated on functional diagrams.
   a. Coordinate operating frequency with other UHF local sources, including but not limited to current television operating frequencies and DTV frequency allocations and/or local public safety operating frequencies to eliminate any interference from outside RF sources.
   b. Provide Receiver unit configured for diversity reception.
   c. Allows the expansion of wireless microphone systems by splitting one pair of antennas to multiple receivers. It also amplifies RF signals to compensate for insertion loss that results from splitting signal power to multiple outputs. A single system can support up to four wireless receivers.
3. Function/Features/Performance:
   a. WMIC
      1) Operating Range Under Typical Conditions: 100m (300 ft.) Note: actual range depends on RF signal absorption, reflection, and interference.
      2) Audio Frequency Response (+/– 2 dB): Minimum: 45 Hz; Maximum: 15 kHz
      3) Total Harmonic Distortion (ref. +/– 38 kHz deviation, 1 kHz tone): 0.5%, typical
      4) Dynamic Range: >100 dB A-weighted
      5) Operating Temperature Range: –18°C (0°F) to +57°C (+135°F) Note: battery characteristics may limit this range
      6) Transmitter Audio Polarity: Positive pressure on microphone diaphragm (or positive voltage applied to tip of WA302 phone plug) produces positive voltage on pin 2 (with respect to pin 3 of low impedance output) and the tip of the high impedance 1/4-inch output.
4. Manufacturer, WMIC System:
   a. Shure QLXD24/SM58 Digital Wireless Handheld System w/ SM58 Cartridge, Shure QLXD14 Bodypack System, and Shure WCE6T Omnidirectional Condenser Rigid Earset Microphone, tan.
   b. Or approved equal.

H. HDMI/DisplayPort w/ Audio Embedding Input Wall Plate **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: MP1
   2. Manufacturer:
      a. Extron DTP T DWP 4k 232 D (District Standard, no substitution)

I. Audio Input Wall Plate **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: MP2
   2. Features:
      a. 1-gang receptacle plate with (2) XLR-F balanced audio jacks
      b. Lockable, weatherproof receptacle cover
   3. Manufacturer:
      a. ProCo
      b. Whirlwind
      c. Or equal

J. Video Extender Set, Transmitter **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: DMTX
   2. Manufacturer
      a. Extron DTP T HWP 4k 231 D (District Standard, no substitution)

K. Multimedia Receiver w/ Scaler **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: DMRX
   2. Manufacturers
      a. Extron DTP HDMI 4K 230 RX (District Standard, no substitution)

L. Multimedia Receiver w/ Scaler w/ audio de-embedding **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: DMRX2
   2. Manufacturers
      a. Extron DTP3 R 201 4K/60 HDMI RX 60-1869-53 (compatible with District Standard, no substitution)

M. USB Extender Set **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: USB-X
   2. Manufacturer:
      a. Extron Extender Plus T (transmitter) 60-1471-12 and R (receiver) 60-1471-13 (compatible with District Standard, no substitution)

N. Document Camera **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: DOCCAM, DCAM
   2. Manufacturer
      a. Elmo TT-12iD (District Standard, no substitution)

2.8 PROJECTION SCREENS

A. Projection Screen, Motorized Retractable, Wall-Mount, **(BASE BID)**
   1. Drawing Reference(s): Projection screen, indicated
   2. Features/Functions:
      a. 137” diagonal
      b. 16:10 Aspect Ratio

3. Manufacturer
   a. Da-lite Tensioned Contour Electrol (District Standard, no substitution)

2.9 VIDEO TERMINAL EQUIPMENT

A. LCD, 55" Diagonal **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: LCD55
   2. Features/Functions:
      a. Panel Type: LCD, LED Backlighting
      b. Professional/commercial grade display warrantied by the manufacturer for continuous operation for not less than two years.
      c. Minimum Viewable Panel Size: 55" diagonal, 16:9 aspect ratio
      d. Maximum Pixel Pitch: 0.923 x 0.923 mm
      e. Native Resolution: 1920 x 1080
      f. Viewing Angle (H/V): 176°/176°
      g. Brightness: 450 cd/m^2
      h. Maximum Response Time: 6 ms
      i. Contrast Ratio: 5000:1
      j. Inputs
         1) VGA (D-sub 15 pin)
         2) HDMI
         3) Stereo Mini Jack
      k. Control:
         1) RS-232C
         2) RJ45
         3) IR, included IR Remote
      l. Power Consumption: In accordance with California Code of Regulations, Title 20: Division 2, Chapter 4, Article 4, Sections 1601-1608: Appliance Efficiency Regulations
      m. Weight: 70 lbs. Maximum
      n. Operating Temperature: 5-40 degrees C
      o. Operating Humidity: 20-80%
      p. Dimensions: Less than 2" deep.
   3. Manufacturer
      a. Samsung ME55B
      b. Sharp
      c. NEC
      d. Or approved equal

B. LCD, 60" Diagonal **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: LCD60
   2. Manufacturer
      a. Samsung UN60KS800DFXZA (District Standard, no substitution)

C. LCD, 70" Diagonal **(ADDITIVE BID ALT. #2)**
   1. Drawing Reference: LCD70
   2. Features/Functions:
      a. Panel Type: LCD, LED Backlighting
      b. Professional/commercial grade display warrantied by the manufacturer for continuous operation for not less than two years.

c. Minimum Viewable Panel Size: 70” diagonal, 16:9 aspect ratio
d. Maximum Pixel Pitch: 0.923 x 0.923 mm
e. Native Resolution: 1920 x 1080
f. Viewing Angle (H/V): 176°/176°
g. Brightness: 450 cd/m^2
h. Maximum Response Time: 6 ms
i. Contrast Ratio: 5000:1
j. Inputs
   1) VGA (D-sub 15 pin)
   2) HDMI
   3) Stereo Mini Jack
k. Control:
   1) RS-232C
   2) RJ45
   3) IR, included IR Remote
l. Power Consumption: In accordance with California Code of Regulations, Title 20: Division 2, Chapter 4, Article 4, Sections 1601-1608: Appliance Efficiency Regulations
m. Weight: 70 lbs. Maximum
n. Operating Temperature: 5-40 degrees C
o. Operating Humidity: 20-80%
p. Dimensions: Less than 2” deep.

3. Manufacturer
   a. Sharp PNR-703
   b. Sharp
   c. NEC
   d. Or approved equal

D. LCD, 80” Diagonal **(ADDITIVE BID ALT. #2)**
1. Drawing Reference: LCD80
2. Features/Functions:
   a. Panel Type: LCD, LED Backlighting
   b. Professional/commercial grade display warrantied by the manufacturer for continuous operation for not less than two years.
   c. Minimum Viewable Panel Size: 80” diagonal, 16:9 aspect ratio
   d. Maximum Pixel Pitch: 0.923 x 0.923 mm
   e. Native Resolution: 1920 x 1080
   f. Viewing Angle (H/V): 176°/176°
   g. Brightness: 450 cd/m^2
   h. Maximum Response Time: 6 ms
   i. Contrast Ratio: 5000:1
   j. Inputs
      1) VGA (D-sub 15 pin)
      2) HDMI
      3) Stereo Mini Jack
   k. Control:
      1) RS-232C
      2) RJ45
      3) IR, included IR Remote

l. Power Consumption: In accordance with California Code of Regulations, Title 20: Division 2, Chapter 4, Article 4, Sections 1601-1608: Appliance Efficiency Regulations
m. Weight: 70 lbs. Maximum
n. Operating Temperature: 5-40 degrees C
o. Operating Humidity: 20-80%
p. Dimensions: Less than 2" deep.

3. Manufacturer
   a. Sharp PNR-803
   b. Sharp
   c. NEC
   d. Or approved equal

E. Video Projector **(ADDITIVE BID ALT. #2)**
1. Drawing Reference: VPROJ
2. Manufacturers, Projectors:
   a. Panasonic PT-RZ570 with lens for installed throw-distance (District Standard, no substitution)

F. Projector Drop Ceiling Mount with Adjustable Pole **(BASE BID)**
1. Construction
   a. Compatible with suspended ceiling systems using 2'x2' or 2'x4' tiles
   b. Up to 50 lbs (22.7 kg) maximum load capacity
   c. Single-space and double-space J-box openings.
   d. Baseplate and pipe: aluminum
   e. Tie wire: steel, 14 AWG, 70,000 psi tensile strength
   f. Dimensions
      1) Base plate 1.2" H x 26.4" W x 8.0" D
      2) (2.9 cm H x 67.0 cm W x 20.3 cm D)
      3) Pipe 25" length, 1.5"-11.5 NPT
   g. Adjustment ranges 1.5" - 23.0" drop, 21.5" adjustability in 0.5" steps
2. Manufacturer
   a. Chief CMA-450, White
   b. Or equal.

2.10 SOUND CABLES AND RELATED

A. General

1. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98 percent of pure copper.

2. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.

   a. Refer to California Electrical Code, Table 725-61. Cable Uses and Permitted Substitutions.

3. Manufacturer part number specified is for a Listed Type CM construction to indicate intended cable construction and quality.

a. Code requirements take precedence.

b. Provide type required by Code at no additional cost to the College.

B. Cable, Microphone and Line Level, General Purpose

1. Drawing Symbol(s): SP, 2A.

2. Description: Shielded, single twisted pair, with #20 AWG color coded stranded conductors and foil shield with drain wire.

3. Performance/Construction

a. Conductors AWG #20.

b. Conductors Stranding: 7 by 28.

c. D.C. Resistance Per 1000 feet 15 ohms maximum.

d. Shield: Aluminum polyester foil with #20 AWG stranded tinned copper drain wire.

e. Diameter 0.24 inch maximum.

4. Where 2A indicated, provide 2 each SP

5. Manufacturer

a. Belden 8762

b. West Penn.

c. Or approved equal.

C. Cable, Microphone and Line Level, Miniature

1. Drawing Symbol: SP, 2A

2. Restriction: For use within fixed equipment racks only.

3. Description: Shielded, single twisted pair, with #22 AWG color coded stranded conductors and foil shield with drain wire.

4. Performance/Construction:

a. Conductors AWG #22.

b. Conductors Stranding: 7 by 30.

c. D.C. Resistance Per 1000 feet: 20 ohms maximum.

d. Shield: Aluminum polyester foil with #24 stranded tinned copper drain wire.

e. Diameter 0.15 inch maximum.

5. Where 2A indicated, provide 2 each SP

6. Manufacturer

a. Belden 8451, 9451, 1266A.

b. Alpha.

c. West Penn.

d. Or approved equal.

D. Cable, Antenna, Assistive Listening System

1. Description

a. Nominal 50 ohms (actual 51 or 52 ohms) coaxial cable.

2. Minimum 97 percent shield coverage.

3. Joint Army Navy (JAN) or Military (MIL) Construction

a. RG-8/U to JAN-C-17A

b. RG-8 A/U to MIL-C-17D

c. RG-9/U to JAN-C-17A.

4. Manufacturer

a. Belden 8237, 9251 or 8242.

b. CommScope.

c. Or approved equal.

E. Cable, Loudspeaker and D.C. Power

1. Drawing Symbol(s)

a. #18TP

b. #16TP

c. #14TP

d. #12TP

2. Description

a. Twisted pair, jacketed, unshielded cables, #12, #14, #16, or #18, as shown on Drawings.

3. Plenum rated where installed in open plenum return voids.

4. Performance/Construction

a. Conductor, AWG: #12, #14, #16, and #18, as noted.

b. Maximum diameter
1) 0.384 inch (#12)
2) 0.332 inch (#14)
3) 0.256 inch (#16)
4) 0.224 inch (#18).

5. Manufacturer

a. Belden.
   1) #12TP, Belden 8477
   2) #14TP, Belden 8473
   3) #16TP, Belden 8471
   4) #18TP, Belden 9740
   5) West Penn.
   6) Or approved equal.

F. Audio & Control Cabling, Underground, in ducts

1. As specified for the applications above with waterblocking construction consisting of two ply tape designed to swell on exposure to water.
2. Jacket is sunlight and moisture resistant
3. NEC CM or CL3 listed or better. Transition to listed cabling type within 50 feet of entering building.
4. Manufacturer listed for underground application subject to extended exposure to standing water.
5. Manufacturer:
   a. West Penn (aquaseal)
   b. Alpha
   c. Belden
   d. Commscope/Isotec
   e. Or approved equal.

2.11 VIDEO CABLES, COPPER COAX AND RELATED

A. General

1. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98 percent of pure copper.
2. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
   a. Refer to California Electrical Code, Table 725-61. Cable Uses and Permitted Substitutions.
   b. Manufacturer part number specified is for a Listed Type CM construction to indicate intended cable construction and quality.
3. Code requirements take precedence.
   a. Provide type required by Code at no additional cost to the College.

B. Cable, Precision Video

1. Drawing Symbol(s): P-VID, V.

2. Description: 100 percent sweep tested from 0.01 to 100 MHz, double braided shield solid center conductor 75 ohms coaxial precision video cable.

3. Performance

   a. Cable Type: Coaxial precision video.

   b. Center Conductor AWG: Twenty (20) bare copper.

   c. Insulation: Polyethylene.

   d. Shield: Tinned copper double braid, minimum 98 percent coverage.

   e. Nominal Impedance: 75 ohms.

   f. Velocity of Propagation: 66 percent.

   g. Attenuation Per 100 feet:
      1) 1.0 MHz: 0.25 dB
      2) 4.5 MHz: 0.45 dB
      3) 10.0 MHz: 0.78 dB.

   h. Jacket: Polyethylene.

   i. Diameter: 0.305 inch maximum.

4. Manufacturer

   a. Belden 8281A or 8281B.

   b. Canare

   c. Gepco

   d. Or approved equal.

C. Cable, Miniature Precision Video

1. Drawing Symbol: Miniature Precision Video.

2. Description: 100 percent sweep tested from 0.01 to 100 MHz, braided shield plus foil shield, stranded center conductor 75 ohms coaxial miniature precision video cable.

3. Performance

   a. Cable Type: Coaxial precision video.

   b. Center Conductor AWG: 22 or 23 bare copper.

   c. Center Conductor Stranding: 7 by 30 or 7 by 32.

   d. D.C. Resistance Per 1000 feet: 15 ohms maximum.

   e. Insulation: Cellular Polyethylene.

   f. Shield: 100 percent foil plus trimmed copper braid, 95 percent coverage.

   g. Nominal Impedance: 75 ohms.

   h. Velocity of Propagation: 66 percent.

   i. Attenuation Per 100 feet:

1) 1.0 MHz: 0.15 dB
2) 10.0 MHz: 1.3 dB
3) 100 MHz: 5.0 dB.

j. Jacket: Polyethylene.

k. Diameter: 0.240 inch maximum.

4. Manufacturer

a. Belden 9209A.

b. Canare LV-61S.

c. Or approved equal.

D. Cable Set, Audio Video, Manufactured

1. Provide signal type as indicated on Drawings.

2. Manufacturer

a. Liberty Wire & Cable Interflex Z-200 and Z-300 Series

b. Markertek

c. Or approved equal.

E. Cable, Data Monitor Precision Video

1. Plan Reference(s):

a. D5

b. 5DVideo

2. Construction

a. 5 miniature high resolution coax cables in an overall shielded overall jacket to transmit analog component video based on the Red-Green-Blue-Horizontal Sync-Vertical Sync (RGBHV) transmission method.

b. Sub cables are color coded Red, Green, Blue, Black, Grey; or approved alternate color coding scheme.

c. Jacket: Code approved equal for application.

d. Overall five sub cable assembly diameter: 0.56" maximum in raceway applications.

e. Center Conductor AWG: Twenty two (22) ga Silver Plated Copper.

f. Insulation: Foamed Teflon.

g. Shield:
1) Each subcable is double shielded
2) Overall cable has 100% tape shield.

3. Approval/Rating:

a. UL: Recognized Type CL2P (Article 725 of NEC) for plenum application, riser rated elsewhere.

4. Performance - each sub-cable:
   a. Resistance: 0.0162 ohms/ft nominal @ 20C
   b. Impedance: 75 ohm nominal
   c. Capacitance: 17.5 pf/ft nominal
   d. Velocity of Propagation: 80% nominal
   e. Time Delay: 1.19ns/ft nominal
   f. Maximum Attenuation Per 100':
      1) 10 MHz: 0.8 dB/100 ft.
      2) 50 MHz: 2.5 dB/100 ft.
      3) 100 MHz: 3.5 dB/100 ft.
      4) 200 MHz: 4.6 dB/100 ft.
      5) 300 MHz: 5.0 dB/100 ft.
      6) 400 MHz: 7.2 dB/100 ft.
      7) 1000 MHz: 14.6 dB/100 ft.
5. Manufacturers:
   a. Altinex CB5100PL in plenum spaces, riser rated elsewhere.
   b. Extron
   c. Belden
   d. Gepco.
   e. Or approved equal.

F. DVI Cabling
1. Drawing Reference: DVI
2. Features/Functions
   a. Supports single link DVI-D signals up to 1920 x 1200 @ 60 Hz and 1080p/60:
   b. Data rates to 4.95 Gbps
   c. Color depth to 24 bits - 8 bits per color
   d. For cable lengths up to 12 feet: 24 AWG copper wire construction
   e. For cable lengths 25 feet and longer: 22 AWG copper wire construction
   f. NEC CM rated
3. Manufacturers, copper cabling and extenders:
   a. Extron
   b. Or approved equal.

G. HDMI Extender

1. Drawing Reference: HDMI Extend, HDMI XTD

2. Minimum Features/Functions/Construction/Performance

   a. Select to suit application and distance.

   b. Video
      1) Maximum data rate 6.75 Gbps (2.25 Gbps per color)
      2) Maximum pixel clock 165 MHz
      3) Resolution range Up to 1920x1200 or 1080p @ 60 Hz; 8, 10, or 12 bit color depth
      4) Formats RGB and YCbCr digital video
      5) Standards DVI 1.0, HDMI, HDCP 1.1, CEA-861E

   c. Video input — transmitter
      1) Number/signal type 1 single link HDMI (or DVI-D*)
      2) Connectors 1 female HDMI type A

   d. Interconnection between transmitter and receiver
      1) Connectors 1 female RJ-45 per unit
      2) Termination standard ANSI/TIA T568B
      3) Signal transmission distance Up to 330' (100 m) using manufacturer's recommended cabling assembly.

   e. Video output — receiver
      1) Number/signal type 1 single link HDMI (or DVI-D*)
      2) Connectors 1 female HDMI type A

3. Manufacturer, provide with with manufacturer's mounting kits and recommended cabling assemblies:

   a. Liberty Wire & Cabling

   b. Or approved equal.

H. VGA Extender

1. Drawing Reference: VGA XTD or as required

2. Provide as required to maintain signal integrity over required cable length

3. Manufacturers:

   a. Any as specified for HDMI extenders above.

2.12 CONTROL AND CONTROL MEDIA CABLING

A. General

1. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98 percent of pure copper.

2. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.

a. Refer to California Electrical Code, Table 725-61. Cable Uses and Permitted Substitutions.

b. Manufacturer part number specified is for a Listed Type CM construction to indicate intended cable construction and quality.

3. Code requirements take precedence.

a. Provide type required by Code at no additional cost to the College.

B. High Speed, TIA/TIA Category Cabling

1. Drawing Reference:** UTP6-4, where ** denotes cable count

2. Construction:

a. Provide horizontal copper cable in accordance with:
1) EIA ANSI/TIA/EIA-568-B.2
2) UL 444,
3) NEMA WC 66 (Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pair)
4) ICEA S-90-661

b. UTP (unshielded twisted pair),

c. 100 ohm impedance

d. Four each individually twisted pair, 22 or 24 AWG conductors,
1) Color code
a) Pair 1 White/Blue Blue
b) Pair 2 White/Orange Orange
c) Pair 3 White/Green Green
d) Pair 4 White/Brown Brown

e. No shield in the sheath.

f. Jacket
1) Thermoplastic jacket
2) Color: Blue unless otherwise indicated.
3) Cable imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular intervals not to exceed 2 feet.
4) The word "FEET" or the abbreviation "FT" shall appear after each length marking.
5) Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.
6) Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.

3. Certification

a. Warrantied by the manufacturer to provide Category 6 performance when installed in accordance with applicable EIA/TIA standards and when terminated with the jacks supplied by the Contractor for this Project.

4. Performance

    a. Assembly electrically meets or exceeds EIA ANSI/TIA/EIA-568-B.2 Category 6 performance standards

5. Manufacturers:

    a. Berk-Tek LANmark-6

    b. Belden/CDT

    c. Berk-Tek

    d. Commscope/Systimax

    e. Commscope/Uniprise

    f. General Cable

    g. Mohawk/CDT

    h. Superior/Essex

    i. Or approved equal

2.13 CONTROL MEDIA CABLING

A. General

1. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98 percent of pure copper.

2. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.

    a. Refer to National Electrical Code, Table 725-61. Cable Uses and Permitted Substitutions.

    b. Manufacturer part number specified is for a Listed Type CM construction to indicate intended cable construction and quality.

3. Code requirements take precedence.

    a. Provide type required by 2016 CEC at no additional cost to the College.

B. Low Speed Audiovisual Cabling

1. Drawing Reference: AVNet

2. 1 cable equivalent to a 1 pair, 18 gauge cable suitable for RS-485 (A/V Net) signaling and remote device powering.

3. Manufacturers:

    a. Crestron

    b. Liberty Wire & Cabling

    c. AMX

d. Extron

e. Or approved equal.

C. Shielded High Definition Category Media Cabling

1. Drawing Reference(s):

a. HCAT MEDIA

2. Features/Functions:

a. Proprietary 4 twisted-pair cable in overall shield designed to transmit manufacturer's proprietary implementation of HDBaseT

3. Manufacturers:

a. Crestron DigitalMedia 8G Cable

b. Liberty Wire & Cabling

c. AMX

d. Extron

e. Or approved equal.

2.14 MISCELLANEOUS PRODUCTS

A. Cable Termination Devices and Related:

1. Screw-type or Tubular Clamp Barrier Blocks:

a. Buchanan 125, 0625 Series.

b. Electrovert

c. TRW-Cinch 140, 141, 142 Series.

d. Weidmuller .

e. Pass & Seymour/Legrand.

f. Phoenix

g. Or approved equal.

2. Tubular Clamp Barrier Blocks, High Density, Switch Block Section

a. Drawing Reference: TB15.

b. Features/Functions
1) Paired screw terminals on opposite sides of insulating base.
2) TB15 Base mounts to DIN rail, providing space beneath TB15 to dress field and source cabling.
3) Terminates range of wire gauges used by Project – at least 30 gage to 10 gage.
4) High density:
a) At least 33 pairs of connections per foot for 12 and smaller gage terminations,

b) At least 16 pairs of connections per foot for 10 gage terminations.

5) Switch Block Section permits load, such as field devices, to be separated from monitoring panel for testing independent of source then restored without disturbing field wiring terminations.

6) Rated at least fifteen (15) amperes at 300V AC/DC

c. Approvals
1) UL

d. Manufacturers:
1) Allen Bradley Isolation Switch Blocks,
a) 1492-H7 for 30 to 12 gage
b) 1492-CE9 for 10 gage.
2) Tyco Buchanan 0135 Series.
3) WECO Electrical Connectors
4) Altech
5) Curtis Industries
6) Electrovert
7) Weidmuller
8) Pass & Seymour/Legrand
9) Phoenix
10) Or approved equal.

3. Low Level Audio Cable Termination, Insulation Displacement Products

a. Coordinate with wire size, type and insulation

b. Manufacturer
1) ADC "Dense Patch".
2) Siemon Model S66M450 with D10 Designation Strip.
3) Any meeting 110TB under Section 17119 – Communications Termination Blocks and Patch Panels of the Base Building Project
4) Or approved equal.

B. Audio and Control Connectors and Related:

1. Circular Audio Connector, Cord, 3 through 5 contacts, gold plated contacts, captive cable clamp strain relief, matte black chrome finish over nickel metal shell

a. Neutrik C-Series, X-Series.

b. Switchcraft.

c. Or approved equal.

2. Circular Audio Connector, Panel mount, male and female devices to fit same panel cutout including fasteners, 3 through 5 contacts, gold plated contacts, matte black chrome finish over nickel metal shell, female receptacles locking type:

a. Neutrik D Series Version L.

b. Switchcraft

c. Or approved equal.

3. Loudspeaker Connector, Panel mount, female devices to fit same panel cutout including fasteners as other panel mount receptacles, 4 contacts, matte black finish Polyamid/graphite shell, female receptacles locking type. UL Component Recognized:
    a. Neutrik NL4MP.
    b. Switchcraft
    c. Or approved equal.

C. Video Connectors and Related

1. Video Connector, BNC type, 75 ohms, Panel, recessed, flush with panel face, insulated from panel, double female
    a. Manufacturer
        1) Canare BCJ-JRU.
        2) Tec Nec
        3) Liberty Wire & Cable/Panelcraft
        4) Or approved equal.
2. Video Connector, BNC type, 75 ohms, Panel, recessed, flush with panel face, insulated from panel, single female to solder pin
    a. Manufacturer
        1) Canare BCJ-RU.
        2) Tec Nec
        3) Liberty Wire & Cable/Panelcraft
        4) Or approved equal.
3. Video connector, BNC type, 75 ohms, cord, crimp applied. Coordinate with cable.
    a. Manufacturer
        1) Amp.
        2) Amphenol.
        3) Augat/LRC Products
        4) Canare.
        5) Kings.
        6) Liberty Wire & Cable/Panelcraft
        7) RFI/Celltronics.
        8) Trompeter.
        9) Or approved equal.
4. Video Precision 75 ohms Terminator, BNC:
    a. Manufacturer
        1) Canare BCP-TA
        2) Trompeter TNAI-1-75.
        3) Or approved equal.
5. XGA Connectors, DB15
    a. Drawing Reference HD15

b. Manufacturer
   1) Amp.
   2) Amphenol.
   3) Canare.
   4) Kings.
   5) Liberty Wire & Cable/Panelcraft
   6) RFI/Celltronics.
   7) Or approved equal.

D. Custom Facility Panels and Rackmount Auxiliary Panels

1. Drawing Reference(s):
   a. MP* - Media Panels, where * is a number indicating the panel type.
   b. FP* - Facility Panels, where * is a number indicating the panel type.
   c. Aux Panel
2. Provide connector types and plate finish as shown. If none shown, provide:
   a. Rack mount panels:
      1) 16 gauge minimum, cold rolled steel or 1/8" minimum aluminum, finish to match rack finish.
      2) At Contractor's option, fabricate using rack mount panels with Decora/Decorator openings and steel plates with specified connectors. Match insert color to panel color provided. Refer to Rack Panel with Decora Openings below.
   b. Wall Panels: 16 gauge minimum cold rolled steel, finish to match surrounding electrical and other low voltage panels.
3. Manufacturers, Rack Mount Panels
   a. BGW Systems Inc.
   b. Conquest
   c. Middle Atlantic Products Universal Connector Panel
   d. Middle Atlantic Products Universal Connector Panel, Modular Custom Connector Panel Systems
   e. ProCo Sound, Inc.
   f. Ultimate Plates and Panels
   g. Or approved equal.
4. Manufacturers, Wall Panels
   a. PanelCrafters Division of Liberty Wire & Cable, Classic Series
   b. FSR
   c. RCI Systems
   d. Middle Atlantic

e. Ultimate Plates and Panels

f. Whirlwind

g. Or approved equal.

5. Manufacturers, Decora/Decorator connector inserts:

a. Connector Plates by Radio Design Labs. Provide specified connectors rear mounted in D-Blank insert for connector combinations not available from RDL.

b. Grey by Pathway Connectivity Solutions. Provide specified connectors rear mounted in 5100 insert for connector combinations not available from Pathway Connectivity Solutions.

6. Manufacturers, Rack Mount Decora Panel Openings

a. Lowell Manufacturing LD8-RMP with Lowell DBB-4 blank Decora plates at openings not fitted with equipment.

b. Middle Atlantic DECP Series

c. Or approved equal.

2.15 POWER DISTRIBUTION EQUIPMENT:

A. Comply with applicable Codes. Provide UL Listed devices suitable for commercial use. Provide all junction boxes, raceway, fittings, wire, supports and fastenings as required for complete installation. Contractor to coordinate plug end of selected strip with rack power receptacles installed under the work of Division 16. Unless otherwise noted, provide receptacles of NEMA 5-15R configuration.

B. Power Sequencer System

1. Drawing References: PWR-SEQ

a. Power Sequencer

b. Fire Alarm Interface – provide where required to shunt system operation on receipt of closure from Fire Alarm system.

c. Sold State Relay (SSR) SSR1 through SSR7

2. Features

a. Power sequencing system.

b. Solid state switching, zero crossing.

c. Sequencing on power up and power down.

d. Front panel button and external closure activation.

e. Alarm terminal to sequence the system down when tripped.

f. UL Listed.

3. Manufacturer

a. FSR Inc. Power Products Group SPC-20 Power Sequencer and SPC-20X Solid State Relay

b. Furman

c. Or approved equal.

C. UPS, Rack Mounted, 1400 VA

1. Drawing Reference: UPS10

2. Features/Functions/Performance:

a. Provide continuous, no-break power with sine wave output.

b. Size to carry connected load at least 10 minutes following loss of power, after at least two hours of charge time.

c. Provide Transient Over-Voltage (TOV) Surge Suppression; comply with ANSI/IEEE C62.41-1980, Category A and Category B.

d. Provide complete isolation from Line.

e. Provide output voltage regulation to ANSI C84.1 for computing equipment.

f. SNMP manageable and status reporting to College's Management console. Provide output KVA, switch-mode power supply rated, not less than 150% of connected load indicated.

g. Rack Mounted

3. Manufacturer:

a. SmartUPS 1400 RM series by American Power Conversion (APC)

b. Trip-Lite

c. Or approved equal.

D. Power Supplies and Related:

1. Drawing Reference: PS24.

2. Relay and Lamp Power Supply:

3. 24 VDC, regulated within 5%. Ripple not greater than 1.5%. Output current rating at least 150% of maximum possible load. Circuit breaker or intrinsic over current protection. UL Recognized or UL Listed.

E. Full Height Receptacle Strip, One (1) Circuit, 15A

1. Features/Construction:

a. Not less than 60" Long

b. Not less than eleven (11) 15A receptacles

c. Integral circuit breaker

d. NEMA 5-15P plug on 6' cord.

e. UL Listed Assembly

f. Provide mounting hardware as necessary to attach to rack interior.

2. Manufacturers.

a. Wiremold Series 7011ULBC.

b. Lowell ACS 1524

c. Geist NSVB200-101S15

d. Hubbell PR206

e. Leviton

f. Middle Atlantic

g. Chatsworth 12848-701

h. Or approved equal.

F. Full Height Receptacle Strip, One (1) Circuit, 20A

1. Features/Construction:

a. Not less than 70" Long

b. Not less than eleven (11) 15A receptacles

c. Integral circuit breaker

d. NEMA 5-20P plug on 6' cord.

e. UL Listed Assembly

f. Provide mounting hardware as necessary to attach to rack interior.

2. Manufacturers. Contractor to coordinate selected strip with rack power receptacles installed under the work of Division 26.

a. Geist NSVB200-102S20

b. Hubbell PR20820DRTL

c. Leviton P104x series

d. Lowell ACS-2024

e. Midde Atlantic PD-1020C-NS

f. Wiremold Series 7011ULBC20.

g. Chatsworth 12848-705

h. Or approved equal.

G. Rackmount Power Panel, Horizontal Mount, User Aux device use:

1. Drawing Reference: POWER.

2. Functions/Features:

a. Front face of panel shall provide two electrical power outlets and a switch. An indicator lamp shall show the presence of AC power when on. The front face of panel shall have a black finish. The rear face shall provide a minimum of at least four receptacles. The panel shall be racked mounted in a maximum of two rack units. The panel shall be Code approved and UL rated for this application.

3. Manufacturers:
   a. Hubbell MCCPSS19TS
   b. Leviton 4515
   c. Geist SP124-1020
   d. Or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform the Work of this Section in accordance with acknowledged industry and professional standards and practices, and the procedures specified herein.

B. Furnish and install (herein, "provide") all materials, devices, components, and equipment required for complete, operational systems.

3.2 PRECONSTRUCTION PROGRAMMING MEETING

A. Not less than 30 calendar days prior to the scheduled completion of the project, Contractor to initiate a request of the College's Representative to schedule an Audiovisual Systems programming meeting.

1. The College's Representative will schedule the meeting at the reasonable mutual convenience of the Contractor and the College's technical systems representatives.
2. The purpose of the meeting is for the College's Representative to indicate to the Contractor how the programmable interfaces of the audiovisual systems are to be implemented, including:
   a. Button assignments and labels for physical button panels
   b. Touchscreen menu hierarchy, scene arrangement, button and background colors, text size, logos
   c. Whether authorization codes or passwords will be required to access special functions/menus.
3. Contractor to document the information received from the College's Representatives at this meeting.

4. Contractor to submit the documentation of the requirements meeting, along with their proposed response to the College's programming requirements in the form of screen shots and system menu flow diagrams as required under Section 27 05 00 – Common Work Results for Communications Audiovisual Systems, 1.4 Submittals.

3.3 WIRING CLASSIFICATION AND RELATED

A. Audio Signal Wiring Classification:

1. Type A-l: Microphone level wiring less than -30 dBμ, 20 Hz to 20 kHz.
2. Type A-2: Line level wiring -30 dBμ to +24 dBμ, 20 Hz to 20 kHz.
3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dBμ, from 20 Hz to 20 kHz.

B. Video and Related Signal Wiring Classification:

1. Type V-1: Baseband and composite video wiring 1 volt peak-to-peak into 75 ohms, 0 to 10.0 MHz.
2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.
3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.
4. Type V-4: MATV system wiring 0.1 to 1000 uV peak-to-peak into 50 or 75 ohms, 47 to 890 MHz.

C. Control Signal Wiring Classifications:

1. Type C-1: DC control wiring 0 to 50 volts.
2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.
3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.

D. Additional Wiring Classifications:

1. Type M-1: DC power wiring 0 to 48 volts.
2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.

E. Wiring Combinations:

1. Except as indicated herein, conduit, wireways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Contract Drawings.
    a. Types A-1, C-1, and M-1.
    b. Types A-2, C-l, C-2, and M-l, runs less than twenty (20) feet.
    c. Types A-2, C-1, and M-1.

d. Types A-3, C-1, C-2, and M-1.

e. Types A-2, V-1, and V-3.

f. Types V-1, V-2, V-3, and C-1.

g. Types M-2 and C-3.

3.4 WIRE AND CABLE INSTALLATION

A. Provide permanent identification of run destination at all raceway terminations.

B. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.

C. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.

D. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards. Outside buildings, make splices only in designated manholes and/or handholes. Protect splices outside of buildings with splicing kits equivalent to Scotchcast Re-enterable. Make splices only with connectors or terminal devices specified herein. Document all splices on Record Drawings.

E. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.

F. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.

G. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.

H. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Provide tool formed thermal expansion loops at cable at manholes, handholes and at both sides of all fixed mounted equipment. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.

I. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

3.5 SIGNAL POLARITY CONVENTION

A. Maintain consistent absolute signal polarity at all connectors, patch points and connection points accessible in the system. Comply with AES26-2001.Where applicable, a positive polarity electrical signal shall yield positive acoustic pressure from the loudspeakers.

B. Audio signal connector convention: Comply with AES 14-1992 (r1998)

Signal	Connector	Wire
Signal Phase	Pin 2	Red or White
Signal Anti-Phase	Pin 3	Black
Signal Ground	Pin 1	Drain Wire

C. Video and RF/MATV Connector Convention:

Signal	Connector	Wire
Signal Phase	Center Pin	Center conductor
Signal Anti-Phase	Shell	Shield
Signal Ground	Shell	Shield

3.6 WIRING PRACTICE

A. Land all non-coaxial field wiring entering each equipment rack at specified terminal devices prior to connection to any equipment or devices within racks. At Contractor's option, such terminals may be located in the equipment racks or in the terminal cabinets provided. Coordinate such selection with Project construction sequence and test procedures specified herein.

B. Identify all wire and cable clearly with permanent labels wrapped about the full circumference within one (1) inch of each connection. Indicate the number designated on the associated field or shop drawing or run sheet, as applies. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations. Conform with the requirements of Section 27 05 00.

C. Apply all crimp connectors only with manufacturer's recommended ratchet type tooling and correct crimp dies for connector and wire size. Plier type crimp tooling shall not be acceptable.

D. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.

E. Make all connections to screw-type barrier blocks with insulated crimp-type spade lugs. Lugs are not required at captive compression terminal type blocks. Provide permanent designation strips designed for use with the terminal blocks provided. Make neat, intelligible markings with indelible markers equivalent to "Sharpie".

F. Tin terminated shield drain wires and insulate with heat shrinkable tubing.

G. Use only rosin core 60/40 tin/lead solder for all solder connections.

H. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.

I. Termination and buildout resistors and related circuit correction components shall be visible. Do not install in connector shells or internally modify equipment. Show locations on Record Drawings.

J. Correct any and all of the following unacceptable wiring conditions:

1. Deformed, brittle or cracked insulation.
2. Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.
3. Cold solder joints.
4. Flux joints.
5. Solder splatter.
6. Ungrommeted, unbushed, or uninsulated wire or cable entries.
7. Deformation or improper radius of wire or cable.

3.7 FINISHES

A. Finishes and materials for Contractor fabricated assemblies such as racks, custom control panels, brackets, blank panels, equipment mounting in furniture or casework, speaker baffles, speaker grille material and in general any item or component herein which is visible shall adhere to the following:

1. Finish shall be as directed by the College's Representative.
2. In the event that the College's Representative provides no direction as to finish, finish shall match exactly the surrounding and adjacent surfaces.
3. Wooden speaker back boxes and baffles shall be painted flat black if not otherwise finished or stained.

3.8 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT FABRICATION

A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.

B. Within each equipment enclosure, provide a full-height multi-circuit ground outlet strip with branch circuit count as shown on drawings; locate on the left side of the equipment enclosure, as viewed from the rear. In each enclosure provide number of receptacles required by present and future equipment indicated on drawings, plus at least two spare receptacles. Provide flexible steel raceway and junction box for connection of power service. Bond internal raceway to rack frame.

C. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.

D. Maintain separation of wiring classifications as specified herein. Separately dress, route and land microphone and line level cables and related on the right side of the equipment enclosure, as viewed from the rear; dress, route, and land loudspeaker level and control cables on the left side of the equipment enclosure, as viewed from the rear.

E. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.

F. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.

G. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.

H. At jackfields, provide service loop to permit removal of jackfields from rack sufficient to conveniently access all jack contacts for routine cleaning and maintenance. Organize the service loop and harness such that reasonable reconnection of jacks and jack normals is possible without cutting apart the harness.

I. Coordinate the design and execution of wire harnessing of multi-bay rack ensembles with conditions of delivery to installation locations at Project Site, and with the requirement herein for test of the completely wired system in the shop prior to delivery to the Project Site. Organize the wiring harnesses such that they will fold within one shippable unit without risk of damage, or provide polarized multipin connectors and related interconnect systems as specified elsewhere herein.

J. At each equipment backboard, provide UL Listed surge suppressing multi-outlet assembly with at least six (6) receptacles.

3.9 EQUIPMENT RACK AND EQUIPMENT TESTING AND ADJUSTING PROCEDURES

A. Conduct procedures in fabrication shop. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report. Request and coordinate verification of submitted test data by the College's Representative. Correct all non-conforming conditions prior to shipment to Project Site. Perform at least the following procedures:

B. Preliminary: Verify:

1. Grounding of devices and equipment. Integrity of signal and electrical system ground connections.
2. Proper provision of power to devices and equipment.
3. Integrity of all insulation, shield terminations and connections.
4. Integrity of soldered connections. Absence of solder splatter, solder bridges.
5. Absence of debris of any kind, tools, etc.
6. Routing and dressing of wire and cable.
7. All wiring, including polarity and continuity, including conformance with wire designations on running sheets, field and shop drawings.
8. Mechanical integrity of all support provisions.

C. Rig temporary power and grounding. Comply with all applicable Codes, regulations and ordinances.

D. Determine the proper sequence of energizing systems to minimize the risk of damage. Energize. Burn in for at least 168 hours.

E. Sound Systems:

1. Gain control settings: Establish tentative normal settings for all gain controls. Set all equalizers flat. Set all automatic gain control devices to bypass. Terminate power amplifier outputs with power load resistors with resistance value within 10% the nominal output impedance of the respective amplifier. Adjust all gain controls on equipment for optimum signal-to-noise ratio and signal balance and, unless they are sub-panel mounted, cap them to prevent tampering. Unless specified or directed otherwise, adjust gains such that in a given system the "front end" operates at unity gain and maintains 10 dB of clip margin referenced to the first onset of clipping of the associated power amplifier(s). Measure and document system gains at 1 kHz. Settings may require further adjustment by the Contractor, a result of testing by the College's Representative.
2. Freedom from parasitic oscillation and radio frequency pickup: Maintain previous setup. Set up for each mode of operation specified in the functional requirements; verify that all systems are free from spurious oscillation and radio-frequency pickup using broadband oscilloscope. Correct any such defects.
3. Hum and noise level/signal to noise level/signal to crosstalk level: Maintain previous setup. Terminate microphone and line-level inputs with shielded resistors of 150 and 600 ohms, respectively. Set available variable gain controls such that full power amplifier output would be achieved with -40 dBm input level at a microphone input and +12 dBm at a line-level input. Measure and document the specified parameters of the system overall for each microphone input channel and line-level input channel. Compare with nominal signal level.
4. Total Harmonic Distortion: Maintain previous setup. Measure at reference operating level at least at 63 Hz, 125 Hz, 1 kHz, 10 kHz.

F. Baseband Video Systems:

1. Picture Monitors:
   a. Apply crosshatch. Verify linearity.
   b. Apply red field. Adjust purity.
   c. Apply SMPTE bars and PLUGE. Adjust to standards.
2. Video Path Test: Use manufacturer's procedures. Use full field or line signals.

G. Data/Graphics Systems:

1. Projector:
   a. Apply crosshatch. Converge at design distance. Verify linearity.
   b. Apply red, green and blue field. Adjust purity.
2. Wideband Component Analog Video Path Test: Use manufacturer's procedures.

H. Control System:

1. Demonstrate complete operation.

3.10 PROJECTION SCREEN INSTALLATION

A. Inspection

1. General: Examine surfaces and rough framing to determine suitability to install screen and mount. Do not start work until unsatisfactory conditions are corrected.

B. Installation

1. Install screen and projector mount horizontal and plumb for proper operation per manufacturer's recommendations. Securely anchor to supporting structure to withstand all loading conditions and strain of service.

C. Adjustment

1. Adjust units as required for smooth operation and alignment as required.
2. Just prior to final acceptance of project, clean the screen surface according to the manufacturer's instructions.
3. Protect completed work from damage until acceptance by the College's Representative.

3.11 LOUDSPEAKER ASSEMBLY INSTALLATION

A. Loudspeakers:

1. Verify proper installation of loudspeaker enclosures and related support.

2. Verify that no loudspeaker assembly is subjected to stresses or loading effects in any way contributing to possible extraordinary failure.

3.12 VIDEO PROJECTOR ASSEMBLY INSTALLATION

A. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of such equipment. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction. Submit in timely manner.

B. Comply with applicable Code and the requirements of the Authorities having jurisdiction.

C. Provide safety factor greater than six (6) or as required by Code, whichever is greater.

D. Mountings shall:

1. Permit projector lens to align with top of projection screen.

2. Permit Video Projector to be re-oriented at least plus or minus 3o from angles shown on the Contract Drawings for optimum picture.

3. Maintain precise location and orientation of Video Projector after such adjustment when subject to normal building motion and Code defined seismic induced building motion.

E. Do not apply any load to building structure without first obtaining written approval of the College's Representative. Obtain per Project procedures.

F. During Acceptance Testing, adjust orientation of Video Projector as directed to achieve optimum picture. Provide workers and ladders as required. Perform such adjustment with no claim for additional cost or time.

3.13 PERMANENTLY INSTALLED MICROPHONES

A. General

1. Orient generally as shown in the plans with respect to area of intended pickup.

B. Ceiling Mount Microphones

1. Review indicated mounting location in the field prior to installation. Verify that location is not associated with excessive levels of vibration or background noise (due to HVAC, Projector fans and loudspeakers installed under the work of this or other projects, audible occupancy sensors. Report such conditions to the College's Representative and obtain direction prior to proceeding.

2. Coordinate installation location of boundary microphones with final floor plan for maximum uniformity of coverage, and maintainance of unobstructed line-of-site between the projector(s) and the screen(s).

3.14 PERMANENTLY INSTALLED PROGRAM AUDIO SPEAKERS

A. At projection screen conditions,

1. Coordinate the installation location with the projector screen to maintain symmetry.

2. Place speakers indicated for mounting at underside of ceiling oriented to place their long dimension parallel to the ceiling plane.

B. Provide resilient mounting vibration isolation at all wall and roof deck supported loudspeakers to minimize coupling of program audio sound into other building spaces. This requirement does not apply to ceiling supported distributed ceiling speakers.

C. Dress cabling neatly and out of side of audience.

D. Orient on adjustable speaker mounts for maximum uniformity of coverage for audience area and maximum gain before feedback at presenter microphones.

3.15 SYSTEMS PERFORMANCE TESTING AND ADJUSTING PROCEDURES

A. Upon completion of the installation of all equipment in an area, perform the following tests and record results. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report. Correct all non-conforming conditions prior to requesting Acceptance Review and Testing. Perform at least the following procedures:

1. Mechanical: Verify:

   a. Integrity of all support provisions.

   b. Absence of debris of any kind, tools, etc.

2. Power and Isolated Ground: Verify:

   a. Isolation of Isolated Ground system from raceway and related ground.

   b. Grounding of devices and equipment. Integrity of signal and technical power system ground connections.

   c. Proper provision of power to devices and equipment.

3. Signal Wiring: Verify:

   a. Integrity of all insulation, shield terminations and connections.

   b. Integrity of soldered connections. Absence of solder splatter, solder bridges.

   c. Routing and dressing of wire and cable.

   d. Continuity, including conformance with wire designations on running sheets, field and shop drawings.

   e. Absence of ground faults.

   f. Polarity.

4. Use the proper sequence of energizing systems to minimize the risk of damage. Energize.
5. Sound Systems, Electronic Tests; confirm:
    a. Gain at 1 kHz.
    b. Maximum output.
    c. Input clipping level.
    d. Frequency response.
    e. Total harmonic distortion.
    f. Signal to noise ration.
    g. Signal to crosstalk ratio.
6. Electro/Acoustic Tests:
    a. Uniformity of coverage.
    b. Electronic and acoustic frequency response/one-third octave equalization. Measure at ear level. Comply with applicable portions of ANSI (SMPTE) PH22.202M-1984, "B chain electro-acoustic response - control rooms and indoor theaters." Adjust to "curve X of B chain characteristic". College's Representative will direct final adjustment.
    c. Maximum continuous sound pressure level (in the reverberant field). Drive systems with broadband pink noise. Sustain for at least five (5) minutes with no system damage. Measure for "A" and "C" weightings at ear level on loudspeaker axis. Turn off noise.
    d. Acoustic signal-to-noise ratio referenced to the specified maximum continuous sound pressure level in the reverberant field. Measure for "A" and "C" weightings at ear level on loudspeaker axis with mechanical systems operating. Present comparison with previous measurement.
7. Video Systems:
    a. Picture Monitors:
        1) Apply crosshatch. Verify linearity.
        2) Apply red field. Adjust purity.
        3) Apply SMPTE bars and PLUGE. Adjust to standards.
    b. Video Path Test: Use NTC Report No. 7 procedures. Use full field or line signals.
        1) Insertion Gain.
        2) Gain/Frequency Distortion.
8. Control System: Demonstrate complete operation.

3.16 LABELING

A. Conform with the requirements of Section 27 41 07 – Identification for Audiovisual Systems.

B. Provide permanent "wedge" type labels on all controls, as applies, to indicate correct settings after systems performance testing and adjustment procedures have been successfully completed.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall furnish and install all equipment including, but not limited to, outlet boxes, wiring, speakers, and all other necessary equipment to provide a complete operating system as indicated with the contract documents. Provide all necessary wall plates, specialty boxes, etc., not provided by others.

B. Under this specification, system shall provide a complete Communication System for the Administrative, Common and Classroom areas.

C. The Communication System shall provide distribution of overhead paging and emergency paging.

1.2 RESPONSIBILITIES

A. Contract documents are detailed only to the extent required to show design intent. It shall be understood and agreed upon by the Contractor that all work described herein shall be complete in every detail.

B. Furnish additional items not mentioned herein to meet requirements as specified without claim for additional payments. Items, may include hardware, rack panels, 66Blocks etc., and other devices that are required for installation.

C. Labor furnished shall be trained and experienced in telecommunication systems.

D. All equipment unless otherwise specified, shall be new, free from defects, and best craftsmanship in its class.

E. All manufactured equipment shall be installed as recommended by the manufacturers, or as indicated in their published installation manual.

F. Furnish and install necessary equipment, back boxes, supports and enclosures.

G. Furnish and install all necessary wire.

H. Furnish shop drawings.

I. Perform initial programming of system and audio level adjustments.

J. Perform final programming of system and audio level adjustments.

K. Provide system documentation including equipment manuals and drawings.

L. Guarantee all equipment and components for their specified period from date of acceptance.

M. Provide information on system requirements to any Contractor responsible for supplying related materials for this system.

N. FCC registration and U.L. listed numbers shall be available.

1.3 SUBMITTALS

A. Submit layout drawings of the communication system and all components.

B. Submit drawings of control equipment showing all major components.

C. Provide block diagrams showing components and relative connections.

D. Submit a certificate showing a completion of installation, programming, and service training from the system manufacture.

E. Submit data sheets on equipment provided.

1.4 QUALIFICATIONS

A. The Contractor shall be from an established and local company providing solutions to the school market for a minimum of 3 (three) years with Telecom/Data Experience.

B. The Contractor shall maintain an adequate parts inventory to perform necessary service and upgrades.

1.5 MAINTENANCE

A. The Contractor shall provide a 12 (twelve)-month guarantee of the installed system against defects in material and workmanship. All warranty material shall be provided at no expense to the Owner. Guarantee period shall begin on the date of acceptance by the Owner or Engineers.

1.6 PLEDGE OF QUALITY

A. The Contractor shall be an authorized dealer of the supplied equipment with full warranty privileges.

B. The Contractor shall inventory the necessary parts in order to maintain and service the equipment being supplied. This equipment inventory shall be in direct relation to total systems installed as recommended by the manufacture.

C. The Contractor shall provide complete drawings detailing all interconnections, panel wiring diagrams, and specification sheets.

1.7 IN-SERVICE TRAINING

A. The Contractor shall furnish in-service training with the system. The sessions shall facilitate the training of personnel in operating classroom equipment, administrative equipment, program distribution, and user programming functions. Manuals and user guides shall be provided at the time of training.

1.8 WIRING

A. Wiring shall be in accordance with the Manufacturer's specifications. Wiring shall meet all local and state codes. All wiring shall be ground and short tested.

1.9. COMMUNICATION SYSTEM

The Communication System shall be a Valcom V-2006A Six Zone One Way Analog Paging system and be expandable to the following functions and features with additional components from the same manufacturer:

A. System shall interface with any telephone system, thus allowing the school(s) to upgrade or replace their intercom/paging system without purchasing a new telephone system to get the features as described herein. Any system that does not allow these features or functions and is proprietary to one or only a few telephone systems shall not be acceptable.

B. Direct dialing, handsfree, and two-way communication from administrative telephones to any location equipped with a talkback speaker.

C. Automatic gain control on intercom speech to assure constant talkback speech level.

D. Distribute an emergency announcement from a telephone to all areas furnished with a loudspeaker. This emergency announcement shall have the highest priority over all system functions.

E. Microprocessor based system capable of handling up to 6 (six) zones.

F. Distribution of general announcements from administrative telephone. This announcement shall be capable of all-call, group call or multiple group calls.

G. Provide announcements from a desktop microphone.

H. Common area speakers shall be hardware assigned to one of the six paging groups.

L. All levels shall be on a priority basis. Incoming intercom calls will be displayed in the order of these levels with Emergency as top priority.

M. Manually distribute an emergency alert tone via pushbutton or interfaced contact closure.

N. Programmable features shall be stored in an E²PROM memory and not be lost due to power failures.

O. Facilities to annunciate incoming intercom calls at multiple administrative phones simultaneously. Calls may be answered from any of the administrative telephones by simply lifting handset or pressing a button on telephone. Once answered the call will automatically be cancelled from other administrative phones.

PART 2 – PRODUCTS

2.0 INTERCOM CONTROL UNIT AND SPEAKERS

A. Shall be a Valcom V-2006A unit capable of six zones.

B. Pre-alert tone for intercom calls.

C. Ability to produce integral tone signals for time tones or emergency tones..

D. One way speakers shall be Valcom V1020-C speaker.

E. One-Way speakers in the common areas (hallways, office areas, etc), shall be Valcom V1020-C speaker with built in volume control.

F. Outside paging horns shall be Valcom V1030-C Horn to be waterproof, UV resistant, and have integrated volume control.

G. System speakers shall use plenum rated 18/4 or 16/4.

H. Provide one unrestricted audio path for communication of hands-free/normal paging, emergency paging only and program material.

I. Provide call confirmation tone at speaker when an intercom call is placed. This verifies that the call has been placed in queue.

2.1 WIRING

A. All wiring shall be listed for the intended purpose. Use Plenum rated 18/4 or 16/4 U.L. listed cable.

B. All interior wiring shall be in accordance with new construction guidelines suggested by the Manufacture; including the speaker and the call-in switch.

2.2 INSTALLATION

A. Complete system shall be installed in accordance with Manufacturer's recommendations.

B. All wiring shall be installed in raceways or plenum rated cable where routed in plenum ceiling areas.

2.3 PROTECTION

A. The contractor shall provide all necessary protection on the AC power feed and on all station lines leaving/entering the building.

B. Provide drawings of protection devices and all relative information.

END OF SECTION 27 51 16

SECTION 27 53 13 – WIRELESS CLOCK SYSTEM

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS & SCOPE

The system is specified as described.

A. Furnish and install a complete new Wireless Clock System using the Primex 72MHz OneVue™ Sync Wireless Clock System.

B. Furnish and install all system equipment, devices, accessories, and material in accordance with these specifications and drawing to provide a complete and operating system.

C. All bids shall be based on the equipment as specified herein. The model designations are that of Primex, Inc. The specifying authority must approve any alternate system

D. System shall include the System Devices
Transmitter (master)
Repeater Transmitter (secondary)
GPS Receiver
Analog Clocks

1.2 RELATED SECTIONS

A. Division 26 “Electrical”

B. Division 26 Section “Common Work Results for Electrical”

1.3 REFERENCES

System devices specified shall meet or exceed the requirements of the following.

A. National Fire Protection Association (NFPA): 1. NFPA 70 - National Electrical Code (NEC).

B. Manufacturer Installation and User Guides and online help system.

1.4 DEFINITIONS

This section provides commonly used terms within this specification.

A. GPS: Global Positioning System, a worldwide system that employs a constellation of satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world's most accurate and reliable time.

B. NTP: Network Time Protocol, used for synchronizing the clocks on computer networks and devices from either a public server or a separate server on a private local area network.

C. UTC: Universal Coordinated Time

1.5 SYSTEM DESCRIPTION

A. System shall operate on a 72MHz frequency. The 72MHz frequency efficiently transmits its signal through common building materials and across longer distances with less interference - ensuring all system devices receive system data updates.

B. System transmitter shall require a FCC license for operation, resulting in a safe and interference free operation.

C. Manufacturer shall offer system transmitters with a variety of power output levels to provide coverage for a single building or an entire campus.

D. System shall wirelessly synchronize clocks and/or timers, and shall be capable of clock readouts in multiple time zones where desired.

E. System shall provide a master time source that is transmitted wirelessly from the system master transmitter to secondary system devices. The master time source can either from a system supplied GPS Receiver or from an OWNER defined internal or external NTP server that the master transmitter can access via the OWNER'S Local Area Network (LAN). Up to three designated NTP Servers may be specified to ensure continuity of time synchronization. The master time will be synchronized to UTC.

F. Hard wiring of system clocks for data communication shall not be required.

G. System clocks shall automatically adjust for Daylight Saving Time in locations where DST is observed.

H. Each system clock and other components shall use both precise time and synchronized time.

I. Digital clocks shall be synchronized to within 10 milliseconds every 10 minutes and the system shall have an internal oscillator that maintains plus or minus four seconds per day between synchronization, so that clock accuracy shall not exceed plus or minus 0.2 seconds.

J. Analog Clocks shall be synchronized to within 10 milliseconds 6 times per day when operating clock strikes 2:01 AM, 6:01 AM, 10:01 AM, 2:01 PM, 6:01 PM, and 10:01 PM, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronization, so that clock accuracy shall not exceed plus or minus 0.2 seconds.

K. System shall include an internal clock reference so that failure to detect the master time source shall not result in the system clocks failing to indicate time. Additionally, system transmitters shall have an internal battery backup of up to eight hours in the event of a power failure so that settings and the correct master time will be instantly recalled upon restoration of power.

L. System shall incorporate a “fail-safe” design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.

M. If a system transmitter stops transmitting valid time signals due to power failure, the system analog clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored for three consecutive days, a clock's second hand will “two-step” as a visual indicator that the signal has been lost. A system digital clock/timer that has not decoded a valid time signal for a three consecutive days will display a visual indicator by flashing its colons continuously until a valid time signal is received. Should clocks lose both power and signal, the clocks will not function.

N. Clock locations shall be as indicated and clocks shall be fully portable, capable of being relocated at any time.

O. System shall provide a mobile configurator app (available for both iOS and Android) that allows OWNER to on-board a new transmitter and manage transmitter settings.

P. System transmitters shall be equipped with Bluetooth® low energy wireless technology that allows the devices to send and receive communication to and from the system mobile configurator app.

Q. System shall include access to the Manufacturer system cloud-based software that allows OWNER to manage and monitor system transmitters and receive remote support services. Optionally, the system transmitters can be set to stand-alone mode, which does not allow for remote support services. A system that requires stand-alone computer-based system software or server hardware for system management or monitoring does not meet the requirements for this specification.

R. U.S. only: System must operate in accordance with a “Radio Station Authorization”, Form FCC 601 – LM, granted by the Federal Communications Commission (FCC). This license will be issued to and held by the end user.

S. CANADA only: The system must operate in accordance with a “Technical Acceptance Certificate” issued under the authority of Industry Canada and the Ministry of Industry. This license will be granted to and held by the end user.

1.6 REGULATORY REQUIREMENTS

A. Equipment and components furnished shall be of Manufacturer latest model.

B. System shall be installed in compliance with local and state authorities having jurisdiction.

C. U.S. only: The end user will hold a license, known as a “Radio Station Authorization” granted by the FCC. This license grants the end user protected use for wireless transmission at the designated frequency. This license will designate a unique “call sign” for each end user.

D. U.S. only: Transmitter and receiver shall comply with Part 90 of FCC rules as follows: This device may not cause harmful interference. This device must accept interference received, including interference that may cause undesired operation. Transmitter frequency shall be governed by FCC Part 90.35. Transmitter output power shall be governed by FCC Part 90 257 (b).

E. CANADA only: The end user will hold a license, known as a “Non Complex Fixed Station” Radio License granted by Industry Canada and the Ministry of Industry. This license grants the end user protected use for wireless transmission at the designated frequency.

F. CANADA only: IC-2365: Application for “License to Install and Operate a Radio Station in Canada” must be completed and signed by end user prior to license issuance. The end user will grant permission for Primex to apply for the license on their behalf. Primex will provide all documents and technical information to Industry Canada for approval. This license will designate a unique “call sign” for each end user.

G. CANADA only: Transmitter and receiver shall comply with RSS 119 of Issue 6 of Industry Canada specifications as follows: This device may not cause harmful interference, and this device must accept interference received, including interference that may cause undesired operation. Transmitter frequency shall be governed by IC: RSS119 Issue Transmitter output power shall be governed by IC: RSS119 Issue 6.

1.7 SUBMITTALS

A. Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure showing available colors, styles, sizes, and finishes of clocks.

B. Samples: Submit one specified system device model(s) for approval. Approved sample(s) shall be tagged and shall be installed in the work at location directed.

C. Manufacturer Instructions: Submit complete installation, set-up and maintenance instructions.

D. Floor plans indicating the location of system transmitter(s), approved by Manufacturer, will be submitted to Owner prior to installation.

E. U.S. only: Operating License: Submit evidence of application for FCC Radio Station Authorization prior to installing equipment. Furnish the license or a copy of the application for the license, to the Owner/End User prior to operating the equipment. The original license must be delivered to the Owner/End User.

F. CANADA only: Submit IC Technical Acceptance Certificate prior to installing equipment. Furnish the license or a copy of the application for the license, to the Owner/End User prior to operating the equipment. The original license must be delivered to the Owner/End User.

1.8 SUBSTITUTIONS

A. Proposed substitutions, to be considered, shall be manufactured of equivalent materials that meet or exceed specified requirements of this Section.

B. Proposed substitutions shall be identified not less than 10 days prior to bid date.

C. Other systems requiring wiring and/or conduit between master and clocks and/or timers will not be accepted.

D. Other systems using wireless technology in an unlicensed frequency range will not be accepted.

E. Other systems using wireless technology where the license is held by any party other than the end user will not be accepted.

1.9 QUALITY ASSURANCE

A. U.S. only: Permits: Operating license for the transmitter from the FCC.

B. CANADA only: IC-2365: Application for “License to Install and Operate a Radio Station in Canada” must be completed and signed by end user prior to license issuance.

C. Qualifications Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented experience including 10 or more years of experience producing GPS wireless time systems.

D. Installer: Company with documented experience in the installation of commercial time systems.

E. Prior to installation a site survey must be performed to determine proper transmitter placement.

1.10 DELIVERY STORAGE AND HANDLING

A. Deliver all components to the site in the Manufacturer original packaging.

B. Packaging shall contain Manufacturer name and address, product identification number, and other related information.

C. Store equipment in finished building and in unopened packaging until ready for installation.

1.11 PROJECT SITE CONDITIONS

A. Clocks and/or Timers shall not be installed until painting and other finish work in each room is complete.

B. Mobile configurator app: installed on a mobile device meeting the app install requirements.

C. Transmitter with an external antenna: Coordinate installation of system antenna for access to the roof to comply with safety standards detailed in Manufacturer instructions and per local codes.

D. GPS Receiver time source: Coordinate installation of device for access to the roof or exterior side wall per Manufacturer installation instructions.

1.12 SYSTEM STARTUP

A. At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all system devices and components are functioning.

1.13 WARRANTY

A. Manufacturer shall provide a 5 year limited warranty on system transmitters, clocks, digital timers, timer control switch, and GPS Receiver.

B. All other system components shall have a 1 year limited warranty, including external antennas and components and universal power supply (UPS).

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. The system and equipment is specified as described in this section.

B. All bids shall be based on the equipment as specified herein. The model designations are that of Primex. The specifying authority must approve an alternate system.

2.2 Manufacturer

A. System shall be manufactured by:
Primex, Inc. 965 Wells St, Lake Geneva, WI 53147 | Phone: (855) 557-0337 | info@primexinc.com | www.primexinc.com

2.3 SYSTEM OPERATION

The system shall perform in the sequence of operation as described below.

A. Install system transmitters and components, including internal or external antenna and optional GPS Receiver, detailed in Manufacturer installation instructions.

B. Configure system transmitter settings through mobile configurator app detailed in Manufacturer instructions.

C. Configure and install system clock devices per model specifications detailed in Manufacturer installation instructions.

Master transmitter operation

A. When power is first applied, it looks for a master time source (first GPS and then NTP). If a master time source is not found, it uses its onboard real time clock (RTC) and continues to search for its master time source. If time source is not found, transmitter is set to a warning state with a time sync failure status, its caution LED status indicator is illuminated, and transmits its state to the system software at its scheduled check-in time (default set to every 5 minutes). If it fails to get time from either source consecutively for 30 minutes (default), it enters an alarm state and its error LED indicator is illuminated. If the RTC clock is off significantly, the transmitter will report a critical error to OneVue. This will occur only after the first 30 minutes of operation if the RTC continues to be significantly off.

B. GPS Time Source: With the transmitter in GPS mode, it powers to a connected GPS receiver mounted with a clear view of the sky. Upon power, the GPS receiver seeks the GPS satellites in orbit to determine position and UTC time. Once the transmitter acknowledges receivable GPS data, it downloads time data and synchronizes its internal master clock to GPS time. The transmitter then starts to transmit its internal time once

every second. The transmitter updates its internal clock every time it receives valid time data from the GPS.

C. NTP Time Source: Transmitter connects over the OWNER'S Ethernet to the IP address of the NTP server. This IP address is programmed into the transmitter as part of its setting configuration. Once the connection to the NTP server is acknowledged, it downloads time data and synchronizes its internal master clock to received NTP time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock in this mode once every 5 minutes by system default (end-user setting). Transmitter configuration allows up to three NTP servers for fail-over purposes.

Clock operation

A. After initial setup, the clock and/or timer shuts off its receiver. Six times each day an analog clock microprocessor activates its receiver and starting with the stored channel it search for a valid time signal. Every 10 minutes a digital clock/timer activates its receiver and starting with the stored channel search for a valid time signal. If necessary, the clocks will resynchronize to the correct time.

B. If an analog clock has not decoded a valid time signal for three consecutive days, it enters step mode. Low battery voltage is a common cause of the clock to not properly decode a time signal. If a clock goes into step mode, replace its batteries first and then determine if the clock synchronizes to master time source before attempting other troubleshooting methods.

C. If a digital clock/timer has not decoded a valid time signal for three consecutive days, its display colon indicator flashes continuously until a valid time signal is received.

2.4 EQUIPMENT

The system shall include all equipment as specified.

Supply following transmitter model(s)

- 1 Watt Transmitter with internal antenna, Ethernet Port (with GPS)
- 1 Watt Transmitter with external antenna, NTP and GPS Input
- 1 Watt Transmitter with internal antenna, NTP or Repeater capability
- 5 Watt Transmitter with external antenna, NTP and GPS input
- 30 Watt Transmitter with external antenna, NTP and GPS input

Transmitter general specifications

A. User-defined settings (mobile app): Time Zone, Daylight Saving Time bypass option, up to three NTP time sources, Power-on Transmit Schedule, Normal Transmit Schedule, Firmware, and Repeater Channel for a secondary (repeater) transmitter.

B. User-defined settings (system software): Legacy Clock Time Zone, Alarm Delay, Firmware, Unresponsive Timeout, and Check-in Interval.

C. Front panel: four LED status indicators (Power, Transmit, Caution, Error) and Bluetooth labeled push-button to pair transmitter with the system mobile configurator app.

D. Rear panel: Network LAN port (RJ-45 Ethernet, 100/10 Mbps, 802.3 Ethernet), GPS In port (MiniDIN 7-Pin), External Antenna connector (coaxial, n-male), Baseboard Monitor port (MiniDIN 9-Pin, for use with 5 or 30 Watt Transmitter only), dry contact closure relay panel (for use with specified Primex products), and pin port to allow end-user connection initiation (check-in) to system software.

E. An onboard real time clock (RTC) such that failure to receive time from master time source will not disable the operation of the system clocks.

F. Time zone adjustment for all time zones in the world and includes Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.

G. Manufacturer or authorized certified installer shall configure the transmitter FCC call sign and RF channel number. These settings are to be predetermined during the FCC licensing process based on system installation location and existing wireless services operating in the area. The OWNER will be required to contact Manufacturer or authorized certified installer if, for any reason, a different broadcast channel is required, since the request would require a modification of the license, requiring approval by the US: FCC or CANADA: by Industry Canada. The system OWNER is the sole proprietor of the FCC License and manufacturer or certified installer are acting as agents. Changes to channel or other FCC regulated configuration settings following the installation by the manufacturer or certified installer are the sole responsibility of the OWNER, and should only be done in accordance with FCC regulations.

1 Watt Transmitter specifications

Transmitter shall meet the specifications below:

A. 1-Watt maximum transmission (at transmitter)

B. 72MHz frequency range

C. 49 channels available (pre-programmed prior to shipment)

D. Dimensions: 17.0”L x 12.0”W x 1.7”D (43.2cm x 30.5cm x 4.32cm)

E. Weight: 9 lb.. (4 kg)

F. Power Supply: Input: 120 VAC, 50/60 Hz, 0.6 Amp | Output: 9 VDC, 2.78 Amp, 6 ft. (1.8 m) cord

G. Operating Range: 32° to 122°F (0° to 50°C)

Internal antenna specifications (1 Watt Transmitter)

Transmitter shall include an internal antenna that is fastened to the top of the unit.

A. Antenna: 46.0 in. L (116.8 cm)

B. Weight: 7.75 lb. (3.5k g)

5 and 30 Watt Transmitter specifications

Transmitter shall meet the specifications below.

A. Operating Frequency Range: 72MHz

B. Enclosure Dimensions: 22”W x 17”H x 22”D (55.88cm x 43.18cm 55.88cm)

C. Approx. Weight: 55 lb. (24.9 kg)

D. Power Supply: 120 VAC, 50/60 Hz, 6.0A Max

E. Oversized heat sink provides adequate cooling

F. Amplifier Output Bandwidth: >20 MHz maximum

External antenna specifications

Transmitter shall include an external antenna that meets the below specifications

A. Antenna connects to the transmitter via a 100 ft. (30.5m) 50-ohm coaxial cable.

B. **5 and 30 Watt models**: External Antenna must be installed by Primex or a certified Primex installer.

C. Cabling: Maximum 100 ft. (30.48 m) between transmitter and antenna

D. FCC Part 90 Accepted

E. IC RSS-119 Accepted

F. Weight: 9 lb. (4.1 kg)

G. Shall include an Outdoor Ground Plane Antenna that meets the specification below:

   Dimensions: 29.4”H x 41.5”W (74.7cm x 105.41cm)
   Lightning Protection: Direct Ground
   Cabling: 100 ft. (30.48 m) between transmitter and antenna provided
   FCC Part 90 Accepted

IC RSS-119 Accepted
Weight: 8.25 lb. (3.75 kg)

GPS Receiver specifications

A. **External Antenna model:** GPS roof mounted with 16 ft. (5 m) cable attached. GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.

B. **Internal Antenna model:** GPS roof mounted, with 10 ft. cable (3 m) attached.

C. An GPS extension cable is available from the Manufacturer, 50 ft. (15.25 m), 100 ft. (30.5 m), or 200 ft. (61 m). Use with an external antenna: total GPS cable length cannot exceed 100 ft. (30.5 m).

D. GPS Receiver cable must be plenum rated where required by local code.

E. GPS connection to main Transmitter requires ferrite bead connector (supplied with transmitter).

Repeater Transmitter

A. Shall receive signal from master Transmitter and transmit the signal to the system devices in its vicinity, which are out of range from the master transmitter.

Analog Clocks

Clocks shall meet the following specifications:

A. Analog clocks shall be wall mounted.

B. Face shall be white. Hour and minute hands shall be black.

C. Additional colors, finishes, and dial faces are available from Manufacturer.

D. Clock faces can be customized by Manufacturer to display organization name or logo as specified.

E. Clock frames and lenses are of durable thermoplastic.

F. Clocks shall have a tamper proof/theft resistant clock-lock mounting slots.

G. Analog clocks shall be capable of automatically adjusting for Daylight Saving Time. An on-off switch located on the transmitter shall disable this function if desired.

H. Clock shall have either a battery-power or a 120 VAC power supply built into the clock assembly.

I. If power is interrupted, the clock will stop until power resumes. Upon resumption of power, the clock will self correct to the current time.

J. Electric (AC) models will include a two prong plug. The power cord can be cut to length and sliced as needed for hard wired installation.

K. Battery-operated analog clocks shall have up to a 5-year battery life. Battery life is based on common operating conditions and may very due to installed site conditions.

L. Installer will furnish clock batteries in accordance with Manufacturer instructions.

M. Time shall be automatically updated from the transmitter 6 times per day.

N. If the transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored after 96 hours, the second hand will “two -step” as a visual indicator that the signal has been lost. Should the clocks lose both power and signal, the clocks will not function.

O. Analog clock receivers shall be as follows: Receiver sensitivity: >-110 dBm, Receiver power: Dual Alkaline batteries or AC-powered, Antenna type: internal, Antenna gain: -7 dBd

P. SUPPLY MODELS - Traditional Series Analog Clocks
(Power Source) Description
(Battery) 9” (22.86cm) Black
(Battery) 12.5” (31.75cm) Black
(Battery) 12.5" (31.75cm) White
Battery) 16" (40.64cm) Black
(Electric) 12.5” (31.75cm) 120VAC Black
(Electric) 12.5” (31.75cm) 120VAC White
(Electric) 16” (40.64cm) 120VAC Black
(Battery) 12.5” (31.75cm) Black, Remote Antenna Clock
(Battery) 12.5” (31.75cm) White, Remote Antenna Clock

Q. SUPPLY MODELS - Slim Series Analog Clocks
Slim Metal Series Clock
(Power Source) Description
(Battery) 12.5" (31.8cm) Slim Mode
(Electric) 12.5" (31.8cm) Slim Mode
(Battery) 16” (40.6cm) Slim Model
(Electric) 16” (40.6cm) Slim Model

R. SUPPLY MODELS - Gallery Series Analog Clocks
Analog Gallery Series
(Power Source) Description
(Battery) 24” (61cm) Distressed Brown Gallery Series Clock Roman Dial

(Battery) 24” (61cm) Distressed Brown Gallery Series Clock Arabic Dial
(Electric) 24” (61cm) Distressed Brown Gallery Series Clock Roman Dial
(Electric) 24” (61cm) Distressed Brown Gallery Series Clock Arabic Dial

S. SUPPLY MODELS - Wood Series Analog Clocks
T. Wood Series Analog Clocks

Battery-Powered Clocks
Description
11.5” (29.21cm) Honey Arabic
11.5” (29.21cm) Honey Roman
11.5” (29.21cm) Dark Cherry Arabic
11.5” (29.21cm) Dark Cherry Roman
11.5” (29.21cm) Clear Oak Arabic
11.5” (29.21cm) Clear Oak Roman
11.5” (29.21cm) Walnut Arabic
11.5” (29.21cm) Walnut Roman
16” (40.64cm) Clear Oak Arabic
16” (40.6cm) Clear Oak Roman
16” (40.64cm) Dark Cherry Arabic
16” (40.6cm) Dark Cherry Roman
16” (40.6cm) Honey Roman
16” (40.6cm) Honey Arabic
16” (40.6cm) Walnut Roman
16” (40.6cm) Walnut Arabic

AC-Powered Clocks
Description
16” (40.64cm) Honey Arabic
16” (40.64cm) Honey Roman
16” (40.64cm) Dark Cherry Arabic
16” (40.64cm) Dark Cherry Roman
16” (40.64cm) Clear Oak Arabic
16” (40.64cm) Clear Oak Roman
16” (40.64cm) Walnut Arabic
16” (40.64cm) Walnut Roman

Digital Clocks

Clocks shall meet the following specifications.

A. Digital Clock must be able to receive synchronized time signal from the master or satellite transmitter.

B. Digital Clock display must include a 12 or 24-hour time display, a PM indicator light, and an alternating time and date display option.

C. Surface-mount models are available from the Manufacturer.

D. Flush-mount models are available from the Manufacturer.

E. Dual-mount models are available from the Manufacturer; dual mount kit.

F. Digital Clock shall be capable of automatically adjusting for Daylight Saving Time.

G. Digital Clock shall have either a 120 VAC or 24 VAC power supply built into the clock assembly.

H. 120 VAC Digital Timer will include a power cord with a two prong plug. Power cord can be trimmed to length and spliced as needed for hard wired installation.

I. 24 VAC Digital timer will include a power cord with pigtail to be hard wired to building 24VAC power grid.

J. Digital Clock must be viewable from 150 ft. (45.7 m).

K. Digital Clock must have highly visible 7-segment LED digits.

L. Digital Clock shall have three display dimmer options, 75%, 50%, and 25%.

M. Digital Clock LED colors, sizes, digit layouts, and mount options are available from the Manufacturer.

N. SUPPLY MODELS - Digital Clocks

Digital Clocks (Levo Series)

Surface-Mount with 2.5" Digits

Description
120VAC, 4° Slope Bracket, 10’ (3.0m) cord with plug
120VAC, 18° Slope Bracket, 10’ (3.0m) cord with plug
24VAC, 4° Slope Bracket, 12” (30.48cm) cord with pigtail
24VAC, 18° Slope Bracket, 12” (30.48cm) cord with pigtail

Surface Mount with 4" Digits

Description
120VAC, 4° Slope Bracket, 10’ (3.0m) cord with plug
24VAC, 4° Slope Bracket, 12” (30.48cm) cord with pigtail

Accessories

A. System shall be available from the same equipment manufacturer.

Analog Clock - Dual Clock Kit
Description
Black - Fits 12.5" Traditional Series or Educational Series Analog Clock
White - Fits 12.5" Traditional Series or Educational Series Analog Clock

Slim Metal Series Clock - Dual Clock Kit
Description
Fits 12.5” (31.75cm) Slim Model Clock
Fits 16” (40.6cm) Slim Model Clock

Digital Clock - Dual Clock Bracket Kit
Ceiling mount: [2", 4-Digit] [2", 6-Digit] [4", 4-Digit] [4", 6-Digit]
Wall mount: [2", 4-Digit] [2", 6-Digit] [4", 4-Digit]

Digital Clock Polycarbonate Clock Guards
Description
2.5" (6.35cm) Guard: 16.0" L x 7.0" H x 5.5"D (40.64cm L x 17.78cm H x 13.97 cm D)
4" (10.16cm) Guard: 25.0" L x 9.8" H x 4.4" D (63.5cm L x 24.9cm H x 11.2 cm D)

Analog Clock Wire Clock Guard
Description
16" Clocks (40.64cm): 18" square x 3"D (45.72cm square x 7.6cm D)

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions with the Installer present for compliance with requirements and other conditions affecting the performance of the system and the system devices.

B. Do not proceed until unsatisfactory conditions have been corrected.

C. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.

D. Verify that 120 VAC electrical outlet is located within 5 ft. (1.5 m) of device and the outlet is operational and properly grounded.

3.2 INSTALLATION

A. General: Install system devices in accordance with applicable codes.

B. Install system devices in accordance with Manufacturer written instructions.

C. Provide all system equipment necessary for a complete and operable system.

D. Comply with requirements of Division 27 Sections "Common Work Results for Communications" and "Communications Horizontal Cabling."

E. Cables: Install cables in raceways and cable trays except within consoles, cabinets, and desks [and except in accessible ceiling spaces and framed partitions where exposed wiring is allowed by Owner]. Install plenum cable where required. Conceal cable installation where possible.

GPS Unit (INTERNAL Antenna Transmitter Model only):

A. Install GPS unit on roof in location indicated, in clear view of the sky.

B. Install unit in location free from standing water and above accumulations of leaves or debris.

C. Seal cable connection to GPS with cable connection sealant.

D. Any added cable lengths must be protected from outside elements.

GPS Unit (EXTERNAL Antenna Transmitter Model only):

A. Locate transmitter in a penthouse, electrical closet or telecommunications room in a central location in the building.

B. Clearance around all side of the transmitter to comply with local building codes.

If GPS Unit will be used as master time source:

A. Attach GPS receiver cable to transmitter back panel.

B. Set GPS/LAN DIP switch to GPS.

If NTP will be used as master time source:

A. Connect CAT5/CAT5e/CAT6 EIA/TIA standard Ethernet cable from transmitter back panel LAN port to available network drop.

Transmitter (EXTERNAL Antenna only)

A. Transmitter is connected to external antenna via a 50 ohm coaxial cable. Typical length is 100 ft. (30.5 m)

B. Cable routing should comply with ANSI EIA/TIA-569 and local building codes.

C. If cable is routed through conduit, the conduit should be a minimum of 2 in. (50.8 mm) diameter.

D. Transmitter enclosure must be bonded to an earth ground per ANSI EIA/TIA 607, NEC Article 250, and local building codes.

E. Antenna should be mounted to a mast on the roof of the building connecting to the transmitter via a 50-ohm coaxial cable.

F. Consult manufacturer instruction manual for specific clearances and mounting instructions.

G. Antenna must be bonded to an earth ground per ANSI EIA/TIA 607, NEC Article 250, and local building codes.

Transmitter (INTERNAL Antenna only)

A. Locate transmitter where indicated, a minimum of 2 to 3 ft. (.6 to 1 m) above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls.

B. Transmitter(s) will be placed at locations indicated within specifications and drawings.

C. Connect antenna to transmitter, using care not to strip threads

D. Connect power supply to the transmitter.

E. Plug power supply into electrical outlet.

Analog Clocks

A. Furnish all equipment necessary for a complete and operational system.

B. Perform the following operations with each clock:

1. Configure and set clock to correct time in accordance with manufacturer instructions.
2. Observe clock until valid signals are received and clock adjusts itself to correct time.
3. Install each clock per its model mounting specifications per manufacturer instructions and mounting instructions at the indicated location

Digital Clocks

A. Cable routing must comply with ANSI EIA/TIA- 569-A and local building codes.

B. Furnish all equipment necessary for a complete and operational system.

C. Perform the following operations with each clock:

1. Configure and set clock to correct time in accordance with manufacturer instructions.
2. Observe clock until valid signals are received and clock adjusts itself to correct time.
3. Install each clock per its model mounting specifications per manufacturer instructions and mounting instructions at the indicated location.

Digital Timers

A. Cable routing must comply with ANSI EIA/TIA- 569-A and local building codes.

B. Furnish all equipment necessary for a complete and operational system.

C. Perform the following operations with each clock:

1. Mount timer per model mounting specifications.
2. Apply power per timer model power specifications.
3. Connect timer to switch control unit with manufacturer provided cable or approved extension cable.
4. Fasten timer to mounting bracket.
5. Set time zone, time date option, and brightness level in accordance with manufacturer instructions and per owner requirements.
6. Observe timer until valid time signal is received and timer displays correct time.

3.3 FIELD INSPECTION

A. Inspection: Make observations to verify that system devices and components are properly labeled.

B. Prior to final acceptance, inspect each system device and component, adjust as required, and replace parts which are found defective.

C. At completion of system device installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that the system and all system devices and components are functioning.

3.4 MANUFACTURER SERVICES

A. System software and device manuals shall be assessable through Manufacturer online knowledge base

B. Provide Manufacturer system commissioning in accordance with Manufacturer written recommendations. Perform operational testing to verify compliance with requirements. Adjust as required.

C. Manufacturer to provide a specified level of system commissioning services.

1. Phone commissioning: system deployment training, including system set up, validation of device configuration, and system functionality by way of a remote web conference.
2. On-site commissioning: system deployment training, including system set up, validation of device configuration, system functionality, verification of device network connections, and device install training.
3. Installation and full on-site commissioning: system training, software configuration, validation of device configuration, training on system functionality, verification of network use, device install training, and device installation.

3.5 CLEANING

A. Prior to final acceptance, clean exposed surfaces of devices, using cleaning methods recommended by Manufacturer.

B. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.6 DEMONSTRATION

A. Provide training to OWNER'S representative on setting, adjusting and configuring device and routine maintenance.

B. Provide training to OWNER'S representative on how to install or access the system provided software, adjusting and programming the transmitter, setting and adjusting system devices and routine maintenance

3.7 PROTECTION

A. Protect finished installation until final acceptance of the project.

3.8 TESTING

A. All devices must be tested at their operational location under normal operational conditions to ensure reception of signal.

END OF SECTION 27 53 13

PART 1 - GENERAL

1.1 SUMMARY

A. This specification describes technical and performance criteria for deploying an Emergenct responder Radio Coverage Antenna System (ERRCS) capable of supporting Public Safety Networks (PSN). The ERRCS components specified in this document include: Donor Antennas, Coverage Antennas, Coax Cable, Coax Connectors, Splitters, Combiners, Couplers, Fiber-Optic Cable, Fiber-Optic Connectors, and Fiber-Optic Jumpers, Bi-Directional Amplifiers (BDA), Fiber-Optic Master Unit and Fiber-Optic Remote Units.

1.2 RELATED SECTIONS

A. 27 05 00 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 27 05 29 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 27 05 33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

E. 27 05 36 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

F. 27 05 53 IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

G. 27 11 16 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

H. 27 11 19 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

I. 27 11 23 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

J. 27 11 26 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

K. 27 13 00 COMMUNICATIONS BACKBONE CABLING

L. 27 13 43 COMMUNICATIONS SERVICES CABLING

M. 27 15 00 COMMUNICATIONS HORIZONTAL CABLING

N. 27 41 33 MASTER ANTENNA TELEVISION SYSTEMS

O. 27 51 16 PUBLIC ADDRESS SYSTEMS

P. 27 52 13 PATIENT MONITORING AND TELEMETRY SYSTEMS

Q. 27 52 23 NURSE CALL/CODE BLUE SYSTEMS

R. 27 53 13 CLOCK SYSTEMS

1.3 SYSTEM DESCRIPTION

A. Services: Upon commissioning, the ERRCS shall provide coverage for the PSNs listed below on all frequencies currently being used by the designated PSN in the given market.

1. NOTE: Below list should be customized for specific project
    a. 700 MHz Public Service
    b. 800 MHz Public Service

B. Expansion: Without replacing the Passive DAS Infrastructure, the DAS shall have expansion capabilities to support the following PSN frequencies deployed in a SISO antenna environment. Any additional Components required for system expansion shall comply with all specifications of this Section.

Service	Uplink	Downlink
700/800 Public Safety	793-805, 806-824	763-775, 851-869

C. PSN Approval: The Contractor shall propose and deploy a DAS system capable of receiving approval of the PSN Authority Having Jurisdiction (AHJ).

D. Network Management:

1. NMS: The DAS shall have a Network Management System (NMS) capable of alarm, monitor, configuration and control of all Active Components.
2. SNMP Integration: The DAS NMS shall be capable of integration with 3rd party SNMP based NMS products for alarm purposes and provide alarming information.

1.4 ALTERNATIVES

A. No alternative component(s) shall be accepted as equal to the components and manufacturers specified in this document unless the Contractor proves the alternative component(s) are of equal or superior specifications and quality, and that they have been used in similar projects of size and complexity for no less than 3 years. The following information shall be required for each alternative component with submittal of the bid response:

1. Passive Components:
    a. Product samples
    b. Detailed product specifications
    c. Independent test results verifying the product specifications
    d. Written documentation from the manufacturer guaranteeing the alternative component(s) shall remain available for new purchase for a period of 7 years from the date of system acceptance.
2. Active Components:
    a. Hardware and software manuals
    b. Detailed product specifications
    c. Mean Time Between Failure (MTBF) data for each Active Component
    d. Independent test results verifying the product specifications

e. Written documentation from the manufacturer guaranteeing the alternative component(s) shall be supported for a period of 7 years from the date of system acceptance.

f. For Active Components serving the PSN, written documentation from the AHJ that the alternative component(s) are approved for use within the PSN and that system acceptance of the DAS to the PSN will not be withheld due to the alternative component being used in the DAS.

1.5 CODES, STANDARDS AND CERTIFICATIONS

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.

B. 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 ERRCS complies with local code, ordinances or requirements established by the PSN AHJ.

1.6 ABBREVIATIONS AND ACRONYMS

A. AHJ: Authority Having Jurisdiction

B. ATP: Acceptance Test Plan

C. BDA: Bi-Direction Amplifier

D. BOM: Bill-of-Material

E. DAS: Distributed Antenna System

F. DAQ: Delivered Audio Quality

G. ESMR: Enhanced Specialized Mobile Radio

H. FCC: Federal Communications Commission

I. LMR: Land Mobile Radio

J. MTBF: Mean Time Between Failure

K. NFPA: National Fire Protection Association

L. NMS: Network Management System

M. PSN: Public Safety Network

N. RoF: Radio-over-Fiber

O. RoHS: Restriction of Hazardous Substances

P. RSL: Received Signal Level

Q. SISO: Single-Input, Single-Output

R. SMR: Specialized Mobile Radio

S. SNMP: Simple Network Management Protocol

T. SOW: Statement of Work

U. VSWR: Voltage Standing Wave Ratio

1.7 DEFINITIONS

A. Acceptance: Expressed approval by the customer

B. Active: ERRCS components that require AC/DC power for operation

C. Channel: A path for an RF transmission between two points

D. Component: A main system element of the ERRCS

E. Contractor: The prime contractor bidding the project

F. Delivered Audio Quality (DAQ): A measure of audio quality over a transmission medium used to quantify the quality of audio heard over a radio system. DAQ levels are defined by the following scale:

1. DAQ 1: Unusable. Speech present but not understandable.
2. DAQ 2: Speech understandable with considerable effort. Requires frequent repetition due to noise or distortion.
3. DAQ 3: Speech understandable with slight effort. Requires occasional repetition due to noise or distortion.
4. DAQ 3.4: Speech understandable without repetition. Some noise or distortion present.
5. DAQ 4: Speech easily understandable. Little noise or distortion.
6. DAQ 5: Perfect. No distortion or noise discernible.

G. ERRCS Sub-contractor: A qualified and experienced ERRCS integrator performing the ERRCS deployment for the Contractor.

H. Head-End Equipment: The equipment that accepts the RF Source, and then typically attenuates, combines, filters and converts the various RF Source signals before transmitting the RF signals to the Remote Units.

I. Passive: ERRCS components that do not require AC/DC power for operation

J. Remote Unit: The equipment that receives the RF signals from the Head-End Equipment, and then typically filters, converts and often amplifies the RF signal before transmitting it to the coverage antenna.

1.8 PERFORMANCE REQUIREMENTS

A. Optical Fiber Infrastructure:

1. General: Optical fiber cabling shall be tested and certified after installation as described below and as required for cable manufacturer's warranty.

2. Fiber testing shall be performed on all optical fibers in completed end-to-end system. Testing shall consist of a bi-directional end-to-end Optical Time Domain Reflectometer (OTDR) trace performed by EIA/TIA-455-61 or a unidirectional end to end power meter test performed by EIA/TIA-455-53A with Single Direction OTDR Trace

3. The system loss measurements shall be provided at 1310 and 1550 nanometers for singlemode optical fibers and 850 and 1300 nanometers for multimode fibers.

4. Optical return loss measurements shall be completed for each fiber at either 1310 or 1550 nm for singlemode. OTDR traces that demonstrate minimum connector and splice performance or a composite ORL test may be used to satisfy this requirement.

5. For spans greater than 90 meters, each tested span must test to a value less than or equal to value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each tested span must be less than or equal to 2.0 dB.

6. The insertion loss for each mated optical fiber connector pair shall not exceed 0.5 dB. Optical return loss shall be < -65 dB @ 1310 and 1550 nm for singlemode fiber.

7. Optical splices shall have an average splice loss of < 0.05 dB with a maximum of 0.10 dB at both 1300 nm and 1550 nm for single mode fiber. Mechanical splices shall have a ORL of -65 dB for singlemode fiber.

8. Pre-installation testing: Test all optical fiber cable for all optical fibers prior to installation of cable.

9. Attenuation testing: Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach test equipment to cable plant. The light source shall be left in place after calibration and power meter moved to far end to take measurements.

10. Loss budget: Fiber links shall have a maximum loss of:

B. (Allowable cable loss by kilometer) × (kilometers of optical fiber in link) + (0.2 decibels) × (number of connectors) + (0.15 dB) X (number of splices) = maximum allowable loss

1. Link loss: A mated connector to connector interface shall be considered a single connector. Loss numbers for installed link shall be calculated by taking sum of bi-directional measurements and dividing that sum by two. All links not meeting requirements of standard shall be brought into compliance by Contractor, at no additional cost to Owner.

2. Documentation: Following final documentation shall be submitted to Owner's Representative prior to commissioning data system and final contract payment according to Submittals in this section:

a. End-to-end loss data

b. Individual splice loss data (where applicable)

c. As installed diagrams

C. PSN DAS:

1. The PSN DAS shall comply with NFPA-1221 current edition as adopted by the AHJ.

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 separate passive cable and coverage Antenna Infrastructure.
3. Contractors shall state the assumed channel count for the PSN Frequency Bands identified above in Section 1.3A. with submittal of bid response. Prior to installation, contractors shall confirm the channel count and frequencies with the AHJ and shall guarantee coverage for these channels per the criteria stated above.
4. The ERRCS shall be capable of upgrade to allow for changes to system frequencies within the deployed frequency band in order to maintain radio system coverage as originally designed.
5. The contractor shall explain the method used to avoid downlink and uplink interference.

1.9 ADDITIONAL REQUIREMENETS

A. PSN Approval: When approval of the ERRCS 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.

1.10 SUBMITTALS

A. Submittal Requirements with Bid Response:
   1. Product Data: Submit manufacturer datasheets for the following components:
      a. Donor and Coverage Antennas or Access Points
      b. Coaxial Cable and Connectors (if used)
      c. Splitters, Combiners and Couplers (if used)
      d. Bi-Directional Amplifiers (BDA) (if used)
      e. All active components included in the DAS
   2. Shop Drawings: Submit the following items:
      a. RF link budget
      b. Overlay of system Components on floor plans
      c. Drawings for Donor Antenna and grounding
      d. Bill-of-Material (BOM)
   3. Statement of Work (SOW): Submit sample SOW
   4. Acceptance Test Plan (ATP): Submit sample ATP
   5. Recommended Spares
   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.

B. Submittal Requirements Prior to Start of Construction
   1. Final RF link budget
   2. Overlay of system Components on floor plans

3. Drawings for Donor Antenna and grounding (if used)
4. RF propagation modeling
5. Bill-of-Material (BOM)
6. Maintenance Service Contract
7. Statement of Work (SOW): The contractor shall submit a SOW that has been accepted by the customer or customer's designated representative.
8. Acceptance Test Plan (ATP): The contractor shall submit an ATP that has been accepted by the customer or customer's designated representative.

C. Submittal Requirements at Close Out

1. Drawings: Submit as-built drawings indicating:
   a. Donor antenna, grounding and lighting protection details (if used)
   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 1.8D have been met.
3. Field Reports: Submit sweep-testing results for all cable runs.
4. Field Reports: Submit OTDR or End-to-End Power Measurement test results for all fiber runs.
5. Operation and Maintenance Data: Submit hardware and software manuals for all Active Components.
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

1.11 QUALITY ASSURANCE

A. Qualifications and Requirements

1. Contractor or ERRCS Sub-contractor shall have a minimum of 4-years full-time experience executing ERRCS work of similar scope and complexity.
2. Contractor or ERRCS Sub-contractor shall have deployed a minimum of 10 ERRCS systems.
3. Contractor or ERRCS Sub-contractor shall have the ability to remotely monitor ERRCS systems.
4. Contractor or ERRCS Sub-contractor shall provide an onsite construction foreman to oversee the installation.
5. Contractor or ERRCS Sub-contractor shall provide a project manager to oversee the ERRCS deployment.

B. Certifications

1. The manufacturer(s) of the ERRCS active components shall maintain a formal authorized and certified value-added reseller program, which consists of routine quality audits of the

participating value-added resellers. The list of authorized value-added resellers shall be published, and the Contractor or ERRCS Sub-contractor shall be listed in the Manufacturer's publication of value-added resellers.

2. Contractor or ERRCS Sub-contractor(s) shall provide manufacturer certification that their personnel have been trained on the passive and active components being installed.

3. Contractor or ERRCS Sub-contractor shall be an authorized and certified value-added reseller for the proposed ERRCS manufacturer of passive and active ERRCS components.

C. Contractor(s) meeting the above certifications, requirements and qualifications include:

1. A valid FCC-issued general radio operators license.

2. Certification of in-building system training issued by a nationally recognized organization, school or a certificate issued by the manufacturer of the equipment.

1.12 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. Fiber-Optic Cable: 25-year limited warranty from date of system acceptance.

4. Active Components: The earliest of 1-year limited warranty from date of system installation or 15 months from date of shipment.

B. Contractor Warranty: Contractor shall warrant the system performance as specified in Section 1.8 for 1-year.

1.13 MAINTENANCE

A. The Contractor shall provide an optional annual maintenance service contract to include:

1. 24x7x365 Remote Monitoring

2. Remote Diagnostics & Repair

3. 24x7x365 Technician Dispatch (On-site within 24 hours)

4. Annual Preventive Maintenance

5. Service Provider Coordination

6. Equipment Warranty Management

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specified Manufacturers for 50 Ohm passive DAS components: Commscope, RFS, Westell, Microlabs, Comba

B. Specified Manufacturers for DAS Active components: Corning MobileAccess

C. Specified Manufacturers for BDA Active components: Comba, Westell, Bird Technologies, Fiplex

D. Specified Manufacturers for Optical fiber components: Corning Cable Systems, Commscope

E. Acceptable Manufacturers: As permitted in Section 1.4

2.2 COMPONENTS

A. Omni-Directional Coverage: Omni-Directional Coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna. *(If UHF services are required as specified in Section 1.3A, the specifications for the Omni-Directional Coverage antenna shall be MARS MA-CQ26-1X or functional equivalent.)*

1. Electrical Band 1:
    a. Frequency Band: 698 – 800 MHz
    b. VSWR: ≤ 1.8:1
    c. Gain: ≥ 1.5 dBi
    d. Maximum input power:
    e. Impedance: 50 Ω
    f. Beamwidth, Horizontal: 360° omnidirectional
    g. Beamwidth, Vertical: 80° nominal
    h. Return Loss: 10.9 dB
2. Electrical Band 2:
    a. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
    b. VSWR: ≤ 1.5:1
    c. Gain: ≥ 1.5 dBi @ 800–960 MHz and ≥ 5.0 dBi @ 1710 – 2700 MHz
    d. Maximum input power:
    e. Impedance: 50 Ω
    f. Beamwidth, Horizontal: 360° omnidirectional
    g. Beamwidth, Vertical: 65° nominal
    h. Return Loss: ≤ 13.9 dB
3. Mechanical:
    a. Connector: 50 Ω N Type
    b. Mounting: Thru-hole ceiling mount
    c. Radome material: ABS, UV resistant
    d. Pigtail cable: Plenum rated
4. Environmental:
    a. Application: Indoor
    b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
    c. Relative Humidity: Up to 100%
5. Regulatory Compliance/Certifications: RoHS 2002/95/EC

B. Directional Coverage Antennas: Directional coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna. *(If UHF services are required as specified in Section 1.3A, the specifications for the Omni-Directional Coverage antenna shall be MARS MA-WA46-1X or functional equivalent.)*

1. Electrical Band 1:
    a. Frequency Band: 698 – 800 MHz
    b. VSWR: ≤ 1.8:1
    c. Gain: ≥ 5.0 dBi @ 698 – 800 MHz
    d. Maximum input power: 50W
    e. Impedance: 50 Ω
    f. Beamwidth, Horizontal: 110° nominal
    g. Polarization: Vertical
    h. Return Loss: ≤ 10.9 dB
2. Electrical Band 2:
    a. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
    b. VSWR: ≤ 1.5:1
    c. Gain: ≥ 5.0 dBi @ 800 – 960 MHz and ≥ 6.0 dBi @ 2170 – 2700 MHz and ≥ 8.0 dBi @ 1710 – 2170 MHz
    d. Maximum input power:
    e. Impedance: 50 Ω
    f. Beamwidth, Horizontal: 90° nominal
    g. Return Loss: ≤ 13.9 dB
3. Mechanical:
    a. Connector: 50 Ω N Type Female
    b. Mounting: 4-hole wall mounting plate
    c. Radome material: ABS, UV resistant
    d. Pigtail cable: RG58, plenum rated
4. Environmental:
    a. Application: Indoor
    b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
    c. Relative Humidity: Up to 100%
5. Regulatory Compliance/Certifications: RoHS 2002/95/EC

C. Air Dielectric, Plenum Rated Cable:

1. Material Characteristics:
    a. Jacket: Halogenated, Fire-Retardant
    b. Outer Conductor Material: Corrugated Aluminum or Corrugated Copper
    c. Inner Conductor Material: Copper-Clad Aluminum Wire
2. Electrical Characteristics:
    a. Impedance: 50 ± 2.0 Ω

b. Frequency Band: 1 - 8800 MHz

c. Peak Power Rating: ≥ 40.0 kW

3. Mechanical Characteristics:

a. Diameter Over Jacket: ≤ .62 in

b. Minimum Bending Radius: 5 in

c. One Time Minimum Bending Radius: 2.5 in

4. Attenuation Characteristics:

Frequency (MHz)	Attenuation (dB/100ft)
150	≤ 0.86
450	≤ 1.565
800	≤ 2.166
2000	≤ 3.716

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

5. Approved Manufacturer: Commscope AL4RPV-50 or equivalent, in accordance with Section 1.4.

D. Foam Dielectric Cable:

1. Material Characteristics:

a. Jacket: Non-halogenated, Fire-Retardant Ployolefin

b. Outer Conductor Material: Corrugated Copper

c. Inner Conductor Material: Copper-Clad Aluminum Wire or Copper Tube

2. Electrical Characteristics:

a. Impedance: 50 ± 1.0 Ω

b. Frequency Band: 1/2” Nominal: 1 - 8800 MHz, 7/8” Nominal: 1 - 5000 MHz

c. Peak Power Rating: ≥ 40.0 kW

3. Mechanical Characteristics:

a. Diameter Over Jacket: 1/2” Nominal: ≤ .63 in, 7/8” Nominal: ≤ 1.1 in

b. Minimum Bending Radius: 1/2” Nominal: ≤ 5 in, 7/8” Nominal: ≤ 10 in

c. One Time Minimum Bending Radius: 1/2” Nominal: ≤ 2 in, 7/8” Nominal: ≤ 5 in

4. Attenuation Characteristics: 1/2” Nominal

Frequency (MHz)	Attenuation (dB/100ft)
150	≤ 0.815
450	≤ 1.447
800	≤ 1.968
2000	≤ 3.251

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

5. Attenuation Characteristics: 7/8” Nominal:

Frequency (MHz)	Attenuation (dB/100ft)
150	≤ 0.417
450	≤ .744
800	≤ 1.014
2000	≤ 1.683

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

E. Splitters, Combiners, Couplers, and Coax Jumpers:

1. Approved Manufacturer: Comba, Commscope, Westell or equivalent, in accordance with Section 1.4.

F. BDA: The BDA shall use digital filtering to mitigate interference and accommodate multiple services for PSNs.

1. Characteristics

a. Operating Temperature Range: -33 °C to +50 °C

b. Filtering: Digital for Public Safety Bands

c. FCC Part 90.219 Type Classification: Class A narrowband for LMR/SMR/ESMR frequency bands

d. Alarming: Shall support both SNMP and SMS using wireless modem

2. Compliance:

a. NFPA: For Public Safety bands, the BDA shall comply with NFPA 1221 In-Building Public Safety Radio Enhancement Systems.

b. FCC: Shall be FCC type certified.

3. Approved Manufacturers: Comba, Westell, Bird Technologies, Fiplex or equivalent, in accordance with Section 1.4.

G. Fiber-Optic Master Unit: When installation requirements dictate an Active fiber ERRCS, the Fiber-Optic Master Unit shall convert radio over coax to Radio-Over-Fiber (RoF) for distribution to Fiber-Optic Remote Units. Master unit shall be capable of utilizing either Multimode or Single Mode fiber. The Master unit shall also support simultaneous deployment of multiple remote power options (low, medium, and high).

1. Approved Manufacturers: SOLiD, Commscope, Corning or equivalent, in accordance with Section 1.4.

H. Fiber-Optic Remote Units: The Fiber-Optic Remote Unit converts the RoF signal back to radio over coax, as well as provides filtering so that multiple frequency bands can reside over the same passive cable and antenna infrastructure. Fiber-Optic remote unit shall be compatible with the Fiber-Optic Master Unit listed above. Remote unit shall be capable of utilizing either Multimode or Single Mode fiber.

1. Approved Manufacturers: SOLiD, Commscope, Corning or equivalent, in accordance with Section 1.4.

I. Fiber-Optic Cable and Connectors:

1. General Specifications:

a. Cables shall be six-fiber or greater, designed for point-to-point applications as well as mid-span access, and shall provide a high-level of protection for optical fiber installed in interior building environments.

b. All cables shall be home run from each remote location to each Fiber Master rack without passing through any intermediate cross-connects. Intermediate splice/aggregation points are allowed.

2. Single Mode Fiber General

a. All fibers in the cable must be usable and meet required specifications.

b. Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.

c. Each optical fiber shall consist of a Germania-doped silica core surrounded by a concentric glass cladding.

d. Each optical fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m2).

e. The fiber shall be coated with a dual layer acrylate protective coating. The coating shall be in physical contact with the cladding surface.

f. The attenuation specification shall be a maximum value for each cabled fiber at 23±5 ºC on the original shipping reel.

3. Single-Mode (Dispersion Un-shifted)

a. The single-mode fiber utilized in the optical fiber cable shall meet ITU G.652 (Tables A, B, C & D), IEC Specification 60793-2-50 Type B1.3, TIA/EIA 492-CAAB and Telcordia Generic Requirements GR-20-CORE.

4. Single-Mode (Dispersion Un-shifted) Bend Improved Loss Optical Fiber

a. The single-mode fiber utilized in the optical fiber cable shall meet ITU G.652 (Table D), ITU G.657 (Table A1), IEC Specification 60793-2-50 Type B1.3 and Telcordia Generic Requirements GR-20-CORE.

5. Single-Mode (Dispersion Un-shifted) Bend-Tolerant Optical Fiber

a. The single-mode bend-improved optical fiber utilized in the optical fiber cable shall meet ITU-T G.652, Table D, ITU-T G.657, Table A2 and B2, IEC Specification 60793-2-50 Type B1.3 and B6_b, and Telcordia Generic Requirements GR-20-CORE.

6. Single-Mode (Dispersion Un-shifted) Bend Insensitive Optical Fiber

a. The single-mode bend insensitive fiber utilized in the optical fiber cable shall meet ITU G.652 (Table D) and ITU G.657 (Table B3).

7. Multimode Fiber General

a. All fibers in the cable must be usable and meet required specifications.

b. Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.

c. Each optical fiber shall consist of a germania-doped silica core surrounded by a concentric glass cladding. The fiber shall be a matched clad design, manufactured by the Outside Vapor Deposition (OVD) process.

d. Each optical fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m2).

e. The fiber shall be coated with a dual layer acrylate protective coating. The coating shall be in physical contact with the cladding surface.

f. The attenuation specification shall be a maximum value for each cabled fiber at 23 ± 5 °C on the original shipping reel.

8. Standard 62.5/125 µm Fiber (OM1)

a. The fiber shall meet the following specifications:

1) EIA/TIA-492AAAA-A-1997, “Detail Specification for 62.5-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers."

2) IEC 60793-2-10, “Product specifications – Sectional specification for category A1 multimode fibres”, Type A1b 62,5/125 µm graded index fiber.

9. Standard 50/125 µm Fiber – 150 (OM2)

a. The fiber shall meet the following specifications:

1) EIA/TIA-492AAAB, "Detail Specification for 50-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers."

2) IEC 60793-2-10, “Product specifications – Sectional specification for category A1 multimode fibres”, Type A1a.1 50/125 µm graded index fiber.

10. Laser-optimized 50/125 µm Fiber – 300 (OM3)

a. The fiber shall meet the following specifications:

1) EIA/TIA-492AAAC, "Detail Specification for 850-nm Laser-Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers."

2) IEC 60793-2-10, “Product specifications – Sectional specification for category A1 multimode fibres”, Type A1a.2 850 nm laser-optimized 50/125 µm graded index fibre.

3) Approved Manufacturer: Corning or equivalent, in accordance with Section 1.4.

J. Fiber-Optic Apparatus:

1. General specifications:

a. Panel shelves and wall mount housing shall be used for combination of splicing pigtails, direct connectorization, or PnP cabling. Shelf shall be designed for use as termination shelf only (direct connector termination) or as splice and termination shelf.

b. Building cabling shall not terminate directly to equipment and patch panels shall be installed at both the head end and remote locations. Panels shall be sized to match fiber count of cable being installed as well as allow for future expansion.

c. Solution shall be able to handle the internal termination of Composite copper DC power and optical fiber cable without the use of 3rd party components. Head end components shall be capable of inclusion of power limiting components that meet NEC requirements.

1) Approved Manufacturer: Corning Cable Systems or equivalent, in accordance with Section 1.4.

K. Fiber-Optic Patchcords:

1. General Specifications:

a. To maintain channel integrity, optical fiber patch cords and pigtails shall be fabricated to meet the performance parameters corresponding to the optical fiber cable approved product type specified below. Patch cord and pigtail plug connectors shall be equipped with boots and shall have same colors as related optical fiber backbone cables, unless specified or indicated otherwise. Optical fiber patch cords shall be available with the following options as specified or indicated:

1) Termination types: SC-APC, LC-APC

2) Connector/cable configuration: Duplex

3) Fire ratings: Riser, plenum and/or LSZH

4) Patch cord outside diameters: 2.0, 2.9 or 3.0 millimeters

5) Lengths: As specified or indicated

6) Approved Manufacturer: Corning Cable Systems or equivalent, in accordance with Section 1.4.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The contractor and/or ERRCS Sub-contractor shall design, install, commission and test the ERRCS in accordance with the manufacturer's instructions and recommendations.

B. The contractor and/or ERRCS Sub-contractor shall install the ERRCS in accordance with the accepted SOW.

C. The contractor and/or ERRCS Sub-contractor shall adhere to all work and safety requirements while working at the job site.

D. The contractor and/or ERRCS Sub-contractor shall have DAS project foreman on site overseeing the installation.

E. The contractor and/or ERRCS Sub-contractor shall have at a minimum one Project Manager on staff overseeing the project. The Project Manager will be responsible for the following:

1. Developing and maintaining a project plan consistent with the overall milestones of the project.
2. Overseeing and coordinating the activities of the ERRCS project, including initiating and holding weekly project conference calls, as well as maintaining and distributing meeting minutes.
3. Act as the point-of-contact interface for all ERRCS project activities.
4. Provide weekly status updates regarding work performed, worked scheduled, open items, problems/issues and resolutions.

F. The contractor and ERRCS Sub-contractor shall be prepared to deploy the ERRCS in a phased approached as dictated by the building construction and/or work of other trades.

G. The contractor and ERRCS Sub-contractor shall facilitate PSN Approval and connection to their respective macro networks.

H. The contractor and ERRCS Sub-contractor shall be prepared to connect to the PSN network(s) in a phased approached as dictated by the PSN and schedules.

3.2 ACCEPTANCE TESTING

A. Acceptance testing will be performed confirming the requirements of Section 1.8 have been met.

B. PSN Acceptance Testing

1. PSN Acceptance Testing shall comply with the following:
   a. The Acceptance Test shall ensure that two-way coverage on each floor of the building meets the minimum coverage requirements detailed in section 1.8.
   b. Tests shall be made using the frequencies listed in Section 1.3A.
   c. Testing shall be coordinated with the Customer and AHJ to ensure no undue interference to any public safety operations.
   d. All testing shall be done on frequencies authorized by the FCC.
2. Test Procedures
   a. The test plan shall ensure testing throughout the building. Testing shall be performed on a grid system. A spot located approximately in the center of a grid area will be selected for the test. Once the spot has been selected, prospecting for a better spot within the grid area will not be permitted. A grid is overlaid onto a floor area to provide 20 grid cells. Grid cells are provided with definite minimum and maximum dimensions. For most buildings, using a minimum grid dimension of 20 ft and a maximum grid dimension of 80 ft will suffice to encompass the entire floor area. A maximum of one area will be allowed to fail the test (95% coverage). Where a floor exceeds 128,000 sq ft, which is the floor area that can be covered by the maximum grid dimension of 80 ft, the floor be subdivided into 40 equal sectors, with each sector being tested individually. A maximum of two non-adjacent areas will be allowed to fail the test (95% coverage). In addition to the above requirement, all critical areas, which include; the emergency command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ, shall be provided with 99 percent floor area radio coverage. Signal strength measurements shall be performed using standardized parameters as specified below.
3. Measurement Parameters
   a. Signal levels shall be measured to ensure the system meets the criteria specified in the Technical Proposal. Downlink measurements shall be made with the following standardized parameters:
   b. Measurements shall be recorded using a calibrated spectrum analyzer or a calibrated automatic signal-level measurement recording system measuring RSSI in each band with a dipole antenna positioned approximately 4’ above the surface.
   c. If P25 Phase II TDMA signals are being measured, the system BER will be measured on a known P25 Phase II TDMA signal. The signal source for measuring the system BER will be provided by the AHJ. The downlink signal level will be measured and the BER will be determined. The DAS coverage will be considered acceptable if the measured BER is five percent (5%) or less.
   d. In addition, the AHJ may conduct portable radio test to show true system performance for P25 Phase I and Phase II TDMA and FDMA services being used on the DAS. These tests shall be conducted using the DAQ scale. A successful test shall include any score measuring DAQ 3.4 or greater.
   e. Measurements will be recorded for the test pattern as described above.
   f. The System uplink noise floor will be measured by connecting a spectrum analyzer to the uplink output of the donor BDA to verify that it agrees with levels predicted by the design link budgets detailed in the Contractor’s TF link budget submittals.
   g. System acceptance is achieved when 95% of the averaged data points meet or exceed the requirements specified here and in Section 1.8.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Section includes, but is not necessarily limited to:

1. Common standards and procedures for the Electronic Safety and Security Work
2. Design, engineer and provide complete, all means of electronic security systems pathway, as well as support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Work of this Division. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.

1.2 RELATED DOCUMENTS

B. Drawings and general provisions of the Contract, including Conditions and Division 1 Specification Sections, apply to this Section.

C. Provisions of this Section apply to Electronic Safety and Security Work, including the following Sections:

1. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
2. Section 28 05 26 – Grounding and Bonding For Electronic Safety And Security
3. Section 28 05 28 – Pathways for Electronic Safety and Security
4. Section 28 13 00 – Access Control and Alarm Systems
5. Section 28 23 00 – Visual Surveillance

1.3 RELATED WORK IN OTHER SECTIONS/DIVISIONS

D. Division 8

1. Provides the electronic door locking hardware, including electronic locks and power transfer hinges.

E. Division 27

1. Installs the structured cabling used to support the Project IP Cameras.

1.4 REFERENCES

F. Usage in accordance with Section 01 42 00 - References

G. Conform to the applicable portions of the following standards agencies:

1. American National Standards Institute (ANSI)
   a. ANSI C39.1 (1981; R 1992) Requirements for Electrical Analog Indicating Instruments

2. ASTM International (ASTM)
    a. ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
    b. ASTM B 32 (2004) Solder Metal
3. Electronic Industries Alliance (EIA)
    a. EIA ANSI/EIA/TIA-232-F (2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
4. National Electrical Manufacturers Association (NEMA)
    a. NEMA ICS 2 (2000) Industrial Controls and Systems: Controllers, Contactors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC
    b. NEMA ICS 6 (1993; R 2001) Industrial Control and Systems: Enclosures
5. Society of Motion Picture and Television Engineers (SMPTE)
    a. SMPTE 170M (1999) Television - Composite Analog Video Signal - NTSC for Studio Applications
6. U.S. National Archives and Records Administration (NARA)
    a. 47 CFR 15 Radio Frequency Devices
7. Underwriters Laboratories (UL)
    a. UL 1037 (1999; Rev thru Sep 1999) Antitheft Alarms and Devices
    b. UL 1076 (1995; Rev thru Feb 1999) Proprietary Burglar Alarm Units and Systems
    c. UL 1610 (1998; Rev Aug 2001) Central-Station Burglar-Alarm Units
    d. UL 294 (1999; Rev thru Oct 2001) Access Control System Units
    e. UL 636 (1996; Rev thru Mar 2001) Holdup Alarm Units and Systems
    f. UL 639 (1997; Rev thru Sep 2002) Intrusion Detection Units
    g. UL 681 (1999; Rev thru Jan 2001) Installation and Classification of Burglar and Holdup Alarm Systems
    h. UL 796 (1999; Rev thru Dec 2003) Printed-Wiring Boards (1982 issue or latest revision).

1.5 DEFINITIONS

H. See also Section 01 42 00 - References, and Section 27 05 00 – Common Work Results for Communications.

I. General Abbreviations used in these specifications. Refer additionally to the abbreviations list appearing on the Drawings.

1. ADA Americans With Disabilities Act.

2. AFC Above Finished Ceiling.
3. AFF Above the Finished Floor.
4. BLDG Building
5. CAT Category
6. CL Centerline
7. DIV Division
8. (E) Existing
9. FBO Furnished By Owner/College
10. HR Home Run
11. ID Inside Diameter
12. LAN Local Area Network
13. MAX Maximum
14. NIC Not In Contract.
15. OD Outside Diameter
16. OFE Owner/College Furnished Equipment.
17. PSRH Project Standard Receptacle Height.
18. PSSH Project Standard Switch Height.
19. TYP Typical
20. UON Unless Otherwise Noted.

J. Definitions of Terms:

1. As defined in Section 28 13 00 – Access Control and Alarm Systems.

1.6 SYSTEM PERFORMANCE REQUIREMENTS

K. As defined in the individual Specification Sections of Division 28.

1.7 SUBMITTALS

L. Submit the following according to Conditions of the Construction Contract and Division 1 Specification Sections.

M. General Requirements

1. Submit all materials for review arranged in same order as Specifications, individually referenced to Specification Section, Paragraph and Contract Drawing number. Conform in every detail as applies to each referencing Section.

2. Submit 8 ½"x 11" items bound in volumes and drawings in edge bound sets. Submit all drawings on sheets of the same size.

3. Make each specified submittal as a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.

N. Progress Schedule: Comply with Section 01 32 19 – Submittal Schedules, Daily Reports and Field Reports.

O. Manufacturer's Product Data:

1. Manufacturer's Product Data Sheets. Collate in sequence of List of Materials:

2. Data sheet for each item in each Electronic Security Section, including all accessories, clearly marked for proposed product required for the Project, to including but not limited to the following where required by the Project scope:

   a. Electronic Security Systems Pathway
      1) Raceway
      2) Raceway connectors
      3) Gutter
      4) Terminal Cans, Pull Boxes, Device Boxes
      5) Enclosures
      6) Means of support

   b. Access Control and Intrusion Device Field Devices provided under the work of the Base Construction Contract
      1) Door position sensors
      2) Request to exit devices

3. Material Safety Data Sheet, where applies.

4. List of Materials Schedule. For each item, include:

   a. Referencing Specification Section

   b. Referencing Paragraph

   c. Referencing Drawing, if specified only on plans

   d. Manufacturer.

   e. Model number.

   f. Listing, including name of Nationally Recognized Testing Laboratory.

   g. Precede each submittal book with a summary schedule, with columns for each item above and rows for each item submitted.
      1) Example:
      2)

Specification Section	Paragraph	Contract Drawing Reference	Manufacturer	Model No.	UL/CLA Listed
28 05 00	2.03C		XYZ	123	Y
28 05 26	2.07A1		AAA	34-56	Y
		TY2.01	ZZY	456	Y

P. Field (Installation) and Shop Drawings: Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Collate in sequence at least the following plans:

1. Drawing index/symbol sheet.
2. Floor plans. At scale of Contract Documents. Show:
    a. Device rough-in locations
    b. Mounting height.
    c. Conduit size.
    d. Rough-in.
3. Sections/Elevations: At scale of Contract Documents:
    a. Mounting location reference.
    b. Terminal cabinets.
    c. Electrical power receptacles required for the work of this Section.
    d. Clearances
4. System Conduit Riser Drawing. Submit drawings that clearly and completely indicate the function of each Electronic Safety and Security component. Indicate termination points of devices, and interconnections required for system operation. Indicate interconnection between modules and devices. Show:
    a. Terminal cabinets.
    b. Coordination with floor plans.
5. Mounting details:
    a. Identify each item requiring seismic restraint installation in accordance with CBC Chapter 16. Include floor mounted items weighing more than 400 pounds and wall mounted or suspended items weighing more than 20 pounds.
    b. Supports for such items shall be provided support, bracing, and anchorage, designed by the Contractor in accordance with the following criteria:
        1) Design to resist seismic forces in accordance with CBC Chapter 16.
        2) Minimum Design Parameters - As defined for the Project in Division 1 and/or on the Code Compliance sheet of the Architectural Plans, with respect to Occupancy Category, Site Classification, Seismic Design Category, Importance Factor, Spectral Acceleration and SDI.
    c. Specific details of restraints including anchor bolts submitted under the Section 27 05 29 – Hangers and Supports for Communications Systems for mounting and maximum loading at each location, showing compliance and

coordination with Code and the project Architectural, Structural and Mechanical Documents.

d. Stamped and signed by an Engineer licensed in the Project jurisdiction for work of this type.
   1) Submit an accompanying Engineering analysis stamped and signed by an Engineer licensed in California for work of this type, indicating that the Equipment Enclosure System will comply with California Building Code for the Project Seismic Zone when loaded with the weight of the equipment submitted.
   2) Show calculations on drawings or in bound volume for review by Authorities having jurisdiction.

e. Show loads, type and strength of connections, sizes, dimensions, materials, etc.

f. Provide details for:
   1) Equipment Rack anchorage.

6. Installation details

   a. Terminal cabinets: Draw elevations of terminal blocks corresponding to the Single Line Diagram.

   b. Firestopping,

   c. Details of flexible raceway connections to be made to vibrating equipment

   d. Details of J-Box and sealant application for the typical conditions listed in Section 27 05 48 – Noise and Vibration Controls for Communications Systems.

   e. California Access Compliance Manual and Americans with Disabilities Act (ADA) compliance.

7. Fabrication details

   a. Receptacles.

   b. Panels.

   c. Special mounting provisions

   d. Legends/engraving details. Half or full size:

8. Schedules of Application

   a. An itemized list of all items of equipment to be fitted with flexible electrical connections.

   b. Catalog cuts of the products to be applied as J-Box mastic and Acoustical Sealant, and a schedule of rooms to receive application of mastic and sealant at J-Boxes.

Q. Hazardous Materials Notification: In the event no product or material is available that does not contain asbestos, PCB or other hazardous materials as determined by the College's Representative, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

1.8 QUALITY ASSURANCE

R. Procedures: In accordance with Section 01 40 00 - Quality Requirements.

S. Designated Supervisor: Provide a designated supervisor present and in responsible charge in the fabrication shop and on the Project Site during all phases of installation and testing of the Work of this Section. This supervisor shall be the same individual through the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.

T. Reference Documents: At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies.

1. A complete set of the latest stamped, actioned submittals of record.

2. A complete set of manufacturer's original operation, instruction and service manuals for each equipment item.

U. Standard Products

1. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section. All components must be of new condition, used or reconditioned products will not be accepted.

a. Alternative Qualifications. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

2. Material and Equipment Manufacturing Date

a. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

V. Manufacturer’s identification tags or marks are not acceptable on surfaces which will remain exposed to view after installation.

1. Evidence of “patching” after removal of tags or marks is not acceptable.

1.9 REGULATORY REQUIREMENTS

W. Regulations Applicable: Including but not limited to those defined in Section 01 42 00 - References.

1. Nothing in the Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, or regulations.

2. Safety Agency Listing: All devices provided under the Work of this Section which are connected to the Project electrical system shall be listed by a Nationally Recognized Testing Laboratory, and shall be so labeled.

3. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the College's Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.10 DELIVERY, STORAGE AND HANDLING

X. Procedures:

1. In accordance with General Conditions and Division 1 Section "Product Requirements", as specified in the individual sections of Division 28 and the following.

a. General

1) Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for cabling and equipment placed in storage.

1.11 ENVIRONMENTAL REQUIREMENTS

Y. Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.

1.12 SEQUENCING

Z. Comply with Section 01 10 00 - Summary of Works and Section 01 32 16 – Construction Project Document.

1.13 OPERATING AND MAINTENANCE DATA

AA. Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the Electronic Safety and Security cabling and pathway system. Precede the manuals with a systems narrative specific to this Project, outlining the major systems functionality, the major systems components, and identifying which manuals document the performance of which subsystems.

1. Submit operations and maintenance data in accordance with Section 01 78 39 – Project Record Documents and as specified herein not later than 2 months prior to the date of beneficial occupancy.

BB. Spare Parts

1. In addition to the requirements of Section 01 77 00 – Closeout Procedures and Section 01 78 23 – Operation and Maintenance Data, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

1.14 PROJECT RECORD DOCUMENTS

CC. Comply with 01 78 00 - Closeout Submittals, and the following.

1. Record Drawings

a. Content
   1) Provide a least as required for the Shop and Installation Drawings defined elsewhere in this Section.
   2) Contractor shall be responsible for updating building and Electronic Safety and Security plans to reflect as-built conditions.
   3) Indicate actual work on Drawings; indicate actual products used, replace vendor neutral nomenclature used in bid set with makes and models of actual installed devices.

b. CAD.
   1) Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. CAD system shall produce files in AutoCAD® .DWG format, latest release at time of Project bid closure. Campus Standard, no substitution permitted.
   2) Except where prohibited by Contract, College's Representative will furnish CAD backgrounds in AutoCAD® .DWG format, for use by the Contractor in preparing Record Drawings.
   3) Disk copy of Record Drawings: Provide 2 separate disc copies of each drawing file in the format noted above. Submit on College Representative's directed media format.

c. Reproduceables: As specified in Division 1.

1.15 WARRANTY SERVICE

DD. In addition to provisions of General Conditions and Division 1 Section "Product Requirements", provide the following.

1. Response Time:

a. Provide an access control manufacturer qualified technician familiar with the work at the Project Site within 24 hours after receipt of a notice of non-emergency malfunction.

b. Provide an access control manufacturer qualified technician familiar with the work at the Project Site within 4 hours after receipt of a notice of an emergency malfunction. An emergency malfunction is defined as one causing gate or door openings to be either inaccessible or unsecured.

c. Provide the College's Representative with telephone number attended 8 hours a day, 7 days a week, to be called in the event of a malfunction.

EE. Provide all additional Warranties as defined in each Electronic Safety and Security Systems Section.

1.16 CLOSEOUT

FF. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, retest and submit Test Report. Notify the College's Representative of completion of Punch List.

GG. Portable Equipment: Furnish all portable equipment and spares to the College's Representative, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.

HH. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit Manuals.

II. Project Record Documents: Submit print and digital copies. Digital files shall be in AutoCAD .dwg format, latest release at time of Project bidding..

JJ. Keys: If applicable, replace construction locks with permanent locks. Provide 5 sets of keys to the College's Representative.

KK. Instruction: Conduct specified instruction.

LL. Warranty: Submit Warranty dated to run from date of Substantial Completion of the Project.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.

B. Each material, device or piece of equipment shall comply with all of the manufacturer's current published specifications for that item.

C. Products shall be made by manufacturers regularly engaged in the production of such products.

D. Provide quantity as shown on Contract Drawings, or as otherwise indicated.

E. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this Section as if specified in full herein.

F. Unless recycled content is specified, provide new materials.

G. Provide the manufacturer's latest design/model, permanently labeled with the manufacturer's name, model number and serial number.

H. Where products are of similar type or use, provide products of the same manufacturer, unless otherwise indicated.

I. Components

1. UL or third party certified. Cabling and interconnecting hardware and components for Electronic Safety and Security systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance.

a. The label or listing by the specified organization will be acceptable evidence of compliance.

b. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the College's Representative.

c. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

J. Enclosures:

1. Provide steel frames and enclosures designed and wired to eliminate all induced currents.

2. Make bolted connections with self-locking devices.

3. All enclosures should be appropriate to environment of installation – refer to the requirements of Section 28 05 28 – Pathways for Electronic Safety and Security.

K. Finishes: Any item or component of the Work of this Section which is visible shall comply with the following.

1. Finishes noted or scheduled on the Contract Drawings take precedence.

2. Where design location requires that products, materials or equipment are visible to the public, no manufacturer's logos larger than 1/2 inch shall be visible. Unless otherwise noted or directed, neatly remove or permanently paint out such logos.

3. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the College's Representative.

2.2 LABELING

L. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

M. Unless otherwise indicated, provide black text on a white background.

N. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

O. Manufacturers

1. Brother P-Touch
2. Brady
3. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing conditions before starting work. Submit conflicts in a timely manner for resolution

3.2 GENERAL

A. Conform to UL 681, UL 1037, and UL 1076, the appropriate installation manual and the requirements of each specification section for each equipment type, whichever is most restrictive . Components within the system shall be configured with appropriate "service points" to pinpoint system trouble in less than 20 minutes.

3.3 PREPARATION

A. Prepare and sequence the work to minimize disruption to each room environment and any existing Electronic Safety and Security systems.

B. Protection: Cover all computers, electronic equipment, desks, chairs, furniture and other articles when working at ceiling level and/or performing dust producing tasks.

3.4 SWITCH INSTALLATION

A. Work of this project includes installation of door position switches, window switches, hatch switches and gate position switches that need to be incorporated with the work of the project in order to prevent rework of construction installed by the work the Project during subsequent installation of the Electronic Security Systems by the College and its contractors.

B. At each condition, switch to be fully installed concealed and integrated into the work of the project with leads extended from each switch to the nearest pullbox installed for aggregation of pathway from the electronic security system devices. As described in Section in 28 05 28 - Pathways for Electronic Safety and Security.

3.5 LABELING

A. Field devices: Each Electronic Security System initiating device and each annunciating device shall be labeled with the assigned ID matching the device ID used in the College's Access Control programming and set-up screens.

1. The ID shall incorporate the device abbreviation, the architectural door number and a sequential number assigned to each device of the same type occurring at

the door opening in the form Door Number - Device Abbreviation – Sequential Number - .

a. Example: One LA at door number 101A: 101A-LA-1.

b. Example: Two DO's at door 121: 121-DO-1, 121-DO-2.

2. Apply label to an unobtrusive spot on the device, cut to minimum practical size before applying.

B. Panels. Attach to the interior of each control a panel clear plastic holder in this holder place a laser printed list of the door and card reader relay points zone numbers and other signals that may be transmitted to the central station, the type of device, exactly what the alarm and restoral signals indicate. This list shall be typed on 8-½" x 11" paper. Provide a copy of these list(s) in Microsoft Word on electronic media format delivered to the College's Representative.

3.6 REPAIR AND RESTORATION

A. Where working in spaces occupied by the College, return to their original positions any furniture or articles relocated to perform the work.

3.7 CLEANING

A. Where working in spaces occupied by the College:

1. Immediately after completing work within each space, clean up and remove all materials, scrap and dust.

2. All scrap material in work area shall be picked up and removed from the building at the end of each day. See also Division 1 for additional requirements.

3. All dust resulting from work performed shall be vacuumed up daily.

4. All scrap material shall be removed from the site and disposed of in an authorized disposal site. Refer to Section 01 74 19 - Construction Waste Management and Disposal.

3.8 SYSTEMS PERFORMANCE TESTING AND ADJUSTING PROCEDURES

A. General Procedures

1. It shall be the responsibility of the Security Contractor to demonstrate to the College's Representative that the security system is complete and functional as per these specifications. For intrusion detection field devices test shall ensure that the requisite degree of intrusion detection is provided.

2. Acceptance testing shall be scheduled by the Security Contractor thorough established project channels

3. Furnish all necessary instruments and equipment required for conducting tests.

B. Device Level Tests

1. Initially, test each sensor and subsystem component individually.

2. Test all wire for shorts, open circuits, or grounding.

3. Immediately correct any defective work

C. Systems Tests.

1. When the function of each component within a particular subsystem such as each sensor within a particular zone is verified, certify that subsystem of the entire Electronic Safety and Security System is satisfactorily meeting required specifications. Test each subsystem similarly until each detection zone has been certified.

2. When subsystem certification is complete, test entire integrated system to ensure that subsystem elements are compatible and function as a complete system. Integrated system test shall be accomplished in linear fashion, end-to-end, and shall verify that each simulated intrusion performed within each detection zone produces an appropriate alarm or signal.

3. Integrated system test shall also verify that alarm is correctly annunciated at the terminal block associated with the field devices,

D. Contractor Testing

1. Provide for approval, not later than 30 days prior to formal inspection and test, a detailed operational test plan of how each component, subsystem, and entire Electronic Safety and Security System will be tested.

2. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Submit prior to request for final payment.

3. Test each individual circuit and device for proper operation in the presence of telecommunications personnel. Correct all failures and retest at contractors expense to verify corrections. Correct as built drawings, O & M manuals, programming sheets and system programming to reflect the College's final occupancy room numbers.

4. Provide College's Acceptance Form with a check box associated with each card reader and input point. A check mark in the box will indicate that each point has been correctly installed and that communication between the controller and the server has been established. This form shall be completed prior to College acceptance of the system.

3.9 COMMISSIONING AND ACCEPTANCE

A. General:

1. Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.

B. Results Expected:

1. Electronic Security Systems shall be complete and ready for use.

2. Testing, start-up and cleaning work shall be complete.

3. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the College.

C. Inspections

1. There shall be three phases of commissioning inspections:

   a. Rough-in inspection

   b. Above-ceiling inspection (after cables are placed)

   c. Final inspection and testing

2. The Contractor shall verify that the installation and materials used have been inspected before they are enclosed within building features, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected and approved.

D. Rough-in inspection. Once electrical rough-in and pathways have been installed, but prior to walls and ceilings being installed, the Contractor shall request of the College's Representative, in writing, for the official rough-in inspection to take place. The College's Representative will then schedule a time to be on-site to conduct this inspection.

1. At a minimum, the College's Representative will evaluate the following items:

   a. Accurate location and height above finished floor for all outlet boxes.

   b. Accurate dimensions (particularly depth) of all outlet boxes and diameter of in-wall conduit serving outlet boxes.

   c. Gutter size, location and clearance.

   d. Location and size of all other electronic security systems conduits or pathways.

   e. Location, spacing and clearance of and around electronic security systems racks and wall-mounted equipment.

   f. That electronic security systems hard wired power and power receptacles, where installed under the work of this project, meet the design requirements.

2. The College's Representative is then to issue a written report to the Contractor identifying all items which currently do not meet the construction document requirements. All items are to be resolved prior to walls and ceilings being closed up. This report is not necessarily all-inclusive; should issues be discovered later in the project, the Contractor is still responsible for corrections/repairs.

E. Above-ceiling inspection

1. Once all electronic security systems cabling has been installed and properly supported and walls have been painted, but prior to the installation of ceiling tiles/material, contractor shall request of the design team, in writing, for the official above-ceiling inspection. The College's Representative will then schedule a time

to be on-site to conduct this inspection

2. At a minimum, the College's Representative will evaluate the following items:
   a. That all items from the previous inspection have been corrected.
   b. That electronic security systems cabling is routed correctly and adequately supported.
   c. That electronic security systems cabling is not painted or over-sprayed.
   d. That the installed electronic security systems cabling matches what was specified/submitted.
   e. That there are no kinks, splices, or other damage to the installed electronic security systems cabling.
   f. That all field devices are properly supported, oriented and labeled.
   g. That all penetrations through fire-rated walls are properly firestopped, including fire blocking materials installed in the annular spaces; and that the firestops are properly labeled.
3. The College's Representative is then to issue a written report to the Contractor identifying all items which currently do not meet the construction document requirements. This report is not necessarily all- inclusive; should issues be discovered later in the project, the appropriate communications subcontractor is still responsible for corrections/repairs.

F. Acceptance Review and Testing Procedures

1. The College's Representative will witness formal Acceptance Tests after receipt of written certification that all prior Punch List work is complete and that Contractor's functionality tests have been completed and that system is ready for final inspection. This request shall be made 3 weeks before substantial completion. The College's Representative will then schedule a time to be on-site to conduct this inspection.
2. The Contractor shall provide the following for the acceptance testing.
   a. Personnel: Provide services of the designated supervisor. Provide quantity of technicians as required to comply with Project Schedule.
   b. All tools appropriate for performance of adjustment of and corrections to this Work. Include spare wire and connectors and specified tooling for application.
   c. Ladders, scaffolding and/or lifts as required to access high devices.
   d. All test equipment.
   e. Complete set of latest stamped, actioned submittals of record for reference.
   f. Complete set of Test Reports.
   g. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.

3. The Contractor shall execute the test plan required in Submittals section and as approved and/or modified by the College's Representative. The testing must demonstrate complete operation of all systems and equipment, including any portable equipment.

4. These procedures may be performed at any hour of the day or night as required by the College's Representative to comply with the Project Schedule and avoid conflict with College staff activities. Provide all specified personnel and equipment at any time without claim for additional cost or time.

5. At a minimum, the College's Representative will check the following items:

   a. Mechanical/Physical Installation.
      1) That all items from the previous inspections have been corrected.
      2) That all electronic security systems equipment and cabling terminal rooms is installed per the contract documents, including all required terminal blocks, pull boxes, termination resistors and electronic security systems grounding.
      3) All other items necessary to guarantee contract documents are met and complete and functioning communications systems are installed.
      4) All cables and electronic security systems field devices and pathway are properly labeled.
      5) All penetrations through fire-rated walls are properly fire-stopped, including fire blocking materials installed in the annular spaces; and that the firestops are properly labeled.

   b. Functionality Demonstration
      1) Demonstrate functionality of each installed device is consistent with the read range, sensitivity and immunity to false alarms as specified by the device manufacturer.
      2) Functional demonstration to also include, but not limited to the following active components and all related items installed under the work of the project:
         a) Door position sensors

6. Door Position, Window and Hatch Switches

   a. Demonstrate functionality of each device. Demonstrate that operation of each monitored door by 1/2" or less from the fully closed position causes the position switch to change state.

G. Adjust: As directed by the College's Representative.

3.10 POST ACCEPTANCE TEST REMEDIATION

A. Temporary Equipment: Provide and operate, without claim for additional cost or time, temporary equipment and/or systems to provide reasonably equivalent function, as determined by the College's Representative, in place of the Work of this Section which is incomplete or found not in conformance with the Contract Documents as of seven (7) days prior to the scheduled completion date. Provide such temporary equipment until Acceptance of the Work of this Section. Thereafter, remove such temporary equipment.

B. Correct:

1. In timely manner, correct identified Work of this Section which is incomplete or found not in conformance with the Contract Documents to comply with the Contract Documents, as reasonably determined by the College's Representative.

2. Conduct additional tests to in the presence of the College's representative to demonstrate that system conforms to the Contract Documents.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes wiring standards for work of Electronic Safety and Security Systems.

B. Related Work Under Other Sections

1. Section 27 10 00 – Structured Cabling, Basic Materials & Methods

a. Defines standards and methods for termination of IP-based cabling used for IP cameras and IP work area outlets necessary to support access control systems installed under the work of Division 28.

2. Section 27 15 00 – Communications Horizontal Cabling

a. Defines materials and execution standards for installation of TIA/ANSI standard category media installed under the work of Division 27 to provide work area outlets for final connection by the work of Division 28 to cameras and IP alarm system panels.

3. Section 28 05 00 – Common Work Results for Electronic Safety and Security.

4. Section 28 05 26 – Grounding and Bonding For Electronic Safety And Security

5. Section 28 05 28 – Pathways for Electronic Safety And Security

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUBMITTALS

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

1.4 REFERENCES

A. American Society For Testing and Materials (ASTM)

1. ASTM A228/A228M-02 Steel Wire, Music Spring Quality.

2. ASTM D 709(2001) Laminated Thermosetting Materials

B. Federal Communications Commission (FCC)

1. The Code of Federal Regulations, Title 47, Telecommunications, Chapter 1 - FCC Part 68 (1982 issue or latest revision) (47 CFR 68) .

C. Institute of Electrical and Electronic Engineers

1. IEEE 383-2003 Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations

2. IEEE 100-00 The Authoritative Dictionary of IEEE Standards Terms

D. Insulated Cable Engineers Association (ICEA)

1. ICEA S-56-434 (1983, 5th Ed.) Reaffirmed October 18, 1991 Polyolefin Insulated Communication Cables for Outdoor Use.

2. ANSI/ICEA S-83-596-2011 Indoor Optical Fiber Cables

3. ANSI/ICEA S-84-608-2010 Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor

4. ANSI/ICEA S-86-634-2011 Buried Distribution & Service Wire, Filled Polyolefin Insulated, Copper Conductor.

5. ANSI/ICEA S-87-640-2011 Fiber Optic Outside Plant Communications Cable

6. ICEA S-102-700-2004 – ICEA Standard For Category 6 Individually Unshielded Twisted Pair Indoor Cables (With Or Without An Overall Shield) For Use In Communications Wiring Systems Technical Requirements

7. ICEA S-103-701-2011 Riser Cables Technical Requirements

E. National Electrical Manufacturers Association (NEMA)

1. NEMA WC 63.1(2000) Twisted Pair Premise Voice and Data Communications Cables

F. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code

G. Telecommunications Industry Association (ANSI/TIA)

1. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises

2. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, 2009

3. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard, published 2009

4. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard, published 2008, including errata issued in October, 2008.

5. ANSI/TIA 569-C (2012) Telecommunications Pathways and Spaces

6. ANSI/TIA-606-B (2012) Administration Standard Telecommunications Infrastructure

7. ANSI- J-STD-607-B (2011) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

H. Underwriters Laboratories, Inc. (UL)

1. UL 444(2002; Bul. 2002, 2003) Communications Cables
2. UL 910(1998) Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
3. UL 1286(1999; R 2004) Office Furnishings
4. UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords. Oct. 2001
5. UL 1666(2000; R 2002) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
6. UL 1863(2000; R 2004) Communications Circuit Accessories
7. UL 969 (1995; R 2001) Marking and Labeling Systems

1.5 QUALITY ASSURANCE

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

1.6 DELIVERY, STORAGE AND HANDLING

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

1.7 WARRANTY

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

PART 2 - PRODUCTS

2.1 CABLING

A. General

1. Where not otherwise specified or indicated, conform to manufacturers most stringent recommendations with respect to pair count, gage, conductor construction and shielding for indicated run length.

2. Conform to Code requirements with respect to acceptable jacket construction for each application and condition. Provide NEC/CEC CMP listed cable construction at plenum at environmental air and underfloor applications.

B. Card Reader Cabling

1. Construction:

a. Conform to Code requirements with respect to acceptable jacket construction for each application and condition

b. 4 pair

c. 22 ga. minimum

d. Overall foil shield with drain wire.

e. Manufacturers:
1) Belden
2) Alpha
3) Commscope/Isotec
4) West Penn
5) or equal.

f. Manufacturers, Alternate Construction:
1) Category 6 cabling as specified in Section 27 15 00.

C. Release Button, Door Switch

1. 2 stranded conductors, 22-18 gauge minimum

2. Manufacturers:

a. Belden 8442, 8461, 5300UE, 5500UE, 6300UE, 6500UE

b. Alpha

c. Commscope/Isotec

d. West Penn

e. or equal.

D. Request to Exit, Motion Detector, Glass Break

1. 4 stranded conductors, 22-18 gauge minimum

2. Manufacturers:

a. Belden 5302UE, 5502UE, 6302UE, 6502UE

b. Alpha

c. Commscope/Isotec

d. West Penn

e. or equal.

E. Combination dual detector

1. 6 stranded conductors, 22-18 gauge minimum
2. Manufacturers:
    a. Belden 5304UE, 5504UE, 6304UE, 6504UE
    b. Alpha
    c. Commscope/Isotec
    d. West Penn
    e. or equal.

F. Lock Power and General Low Voltage Power, Indoor Applications

1. 2 stranded conductors, 16-18 gauge minimum. Size to exceed manufacturers minimum recommendations for voltage drop for required run lengths.
2. Manufacturers:
    a. Belden 5300UE, 5200UE, 6300UE, 6200UE
    b. Alpha
    c. Commscope/Isotec
    d. West Penn
    e. or equal.

G. RS-232 Cabling

1. At least 2-3 pairs, actual pair count as required by interface.
2. 22 gauge minimum, paired construction.
3. Overall foil shield with drain wire
4. Manufacturers:
    a. Belden 9855, 89855
    b. Alpha
    c. Commscope/Isotec
    d. West Penn
    e. or equal.

H. RS-485 Cabling

1. At least 2 pairs, or as required by interface.
2. 18 gauge minimum, paired construction.
3. Overall foil and braid shield with drain wire
4. Manufacturers:
    a. Belden 9842, 82842

b. Alpha

c. Commscope/Isotec

d. West Penn

e. or equal.

I. Control Cabling, Underground, in ducts

1. As specified for the applications above with waterblocking construction consisting of two ply tape designed to swell on exposure to water.

2. Jacket is sunlight and moisture resistant

3. NEC CM or CL3 listed or better. Transition to listed cabling type within 50 feet of entering building.

4. Manufacturer listed for underground application subject to extended exposure to standing water.

5. Manufacturer:

a. West Penn Aquaseal

b. Alpha

c. Belden

d. Commscope/Isotec

e. or equal.

2.2 ELECTRONIC SECURITY SYSTEMS CABLING LABELS, INTERIOR

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

C. Provide vinyl substrate with a white printing area and black print. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.

D. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.

E. Shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing.

F. Manufacturers:

1. Brady

2. Brother

3. Panduit

4. Or equal.

2.3 ELECTRONIC SECURITY SYSTEMS CABLE LABELS, OUTSIDE PLANT

A. Cable Tags in Manholes, Handholes, and Vaults

1. Provide tags for communications cable or wire located in manholes, handholes, and vaults.
    a. The tags shall be polyethylene.
    b. Machine printed - Do not provide handwritten letters.
2. Polyethylene Cable Tags
    a. Provide tags of polyethylene that have an average tensile strength of 22.4 MPa (3250 pounds per square inch) 3250 pounds per square inch; and that are two millimeter (0.08 inch) 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 77 degrees C 170 degrees F.
    b. Provide 1.3 mm (0.05 inch) 0.05 inch (minimum) thick black polyethylene tag holder.
    c. Provide a one-piece nylon, self-locking tie at each end of the cable tag.
    d. Ties shall have a minimum loop tensile strength of 778.75 N (175 pounds) 175 pounds. The cable tags shall have black block letters, numbers, and symbols 25 mm (one inch) one inch high on a yellow background.
    e. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.
3. Manufacturers:
    a. Panduit
    b. Brady
    c. or equal.

PART 3 - EXECUTION

3.1 WIRING CLASSIFICATION AND RELATED

A. Audio Signal Wiring Classification:

1. Type A-l: Microphone level wiring less than -30 dBu, 20 Hz to 20 kHz.
2. Type A-2: Line level wiring -30 dBu to +24 dBu, 20 Hz to 20 kHz.
3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dBu, from 20 Hz to 20 kHz.

B. Video and Related Signal Wiring Classification:

1. Type V-1: Baseband and composite video wiring 1 volt peak-to-peak into 75 ohms, 0 to 10.0 MHz.

2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.

3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.

4. Type V-4: MATV system wiring 0.1 to 1000 microVolts peak-to-peak into 50 or 75 ohms, 47 to 890 MHz.

C. Control Signal Wiring Classifications:

1. Type C-1: DC control wiring 0 to 50 volts.

2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.

3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.

D. Additional Wiring Classifications:

1. Type M-1: DC power wiring 0 to 48 volts.

2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.

3. Wiring Combinations:

E. Except as indicated herein, conduit, wireways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Drawings.

1. Types A-1, C-1, and M-1.

2. Types A-2, C-l, C-2, and M-l, runs less than 20 feet.

3. Types A-2, C-1, and M-1.

4. Types A-3, C-1, C-2, and M-1.

5. Types A-2, V-1, and V-3.

6. Types V-1, V-2, V-3, and C-1.

7. Types M-2 and C-3.

3.2 WIRING PRACTICE

A. All wiring of Division 28 to be installed in raceway except above accessible ceilings.

1. Separate raceway systems, including backboxes and conduit, shall be provided for to electromagnetically isolate electric lock and door motor operators, local door alarms and other similarly powered sources of electro-magnetic noise from door position switches, card reader, door release buttons, duress alarms and similar low power, electromagnetic noise sensitive applications. Refer to Wiring Classification and Related above and comply.

2. Minimum conduit size for multiple conductor runs shall be ¾". In each control panel two empty ¾" conduits shall be installed for future use. These conduits shall be routed to an accessible area above the ceiling or to a location approved by College. Run circuits for AC separate from circuits using DC. Each supervisory/data loop shall be run separately from any other supervisory/data loops they shall not be permitted to share the same conduit. From security alarm control panel provide one ¾" conduit to nearest telephone backboard or panel location for tie-in to College furnished central station. Provide min 1" conduit to each card access or exterior door, unless otherwise shown or scheduled on the plans

3. Conduits including flexible metal and armored cable shall terminate in the sensor or device enclosure.

4. Ends of conduit shall be fitted with insulated bushings. Exposed conductors at ends of conduits external to sensors and devices are not acceptable.

5. Refer to additional requirements in Section 28 05 28 - Pathways For Electronic Safety And Security.

B. All field wiring shall run continuous from device to device no splices shall be permitted except at specified terminal blocks installed in lockable termination cabinets.

1. The use of wire nuts and crimp type connectors shall not be permitted.

2. Where shielded wire is used it shall be connected to an earth ground at the panel. Tin terminated shield drain wires and insulate with heat shrinkable tubing.

3. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point.

4. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.

5. Security alarm conductor terminations in control panels, termination cabinets, junction boxes and annunciator panels to be made on specified terminal strips with a separate point for each conductor.

a. All such strips to be number identified as shown in wiring diagram attached to inside of door of control panel.

b. Connect wiring neatly to terminals strips.

c. Set up termination of cabling so that section of the system may be isolated or shorted out for servicing.

C. No control panel shall be mounted where is not readily accessible the highest connection point shall not be above 6'-6"' nor shall the bottom of the panel be below 30".

D. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.

E. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.

3.3 LABELING

A. Label each end of each cable to indicate its terminal point.

1. For field devices, use the device label assigned per the requirements of Section 28 05 00 - Common Work Results for Electronic Safety and Security.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Work Under Other Sections

1. Section 26 05 26 – Grounding & Bonding for Electrical Systems
2. Section 27 05 26 – Grounding and Bonding For Communications Systems
3. Section 28 05 00 – Common Work Results for Electronic Safety and Security
4. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
5. Section 28 05 28 – Pathway for Electronic Safety and Security

1.2 SUMMARY

A. This section includes grounding and bonding of Electronic Safety and Security Work, including but not limited to:

1. Electronic Safety and Security Raceways
2. Cable Shields
3. Electronic Safety and Security Cabinets and Enclosures.

1.3 SYSTEM DESCRIPTION

A. Provide Electronic Safety and Security Grounding System as described herein and indicated on drawings.

B. Except as otherwise indicated, the complete Electronic Safety and Security installation including the racks, cabinets, panels, cable tray, runway, lightning protectors cable shields and splice cases provided under the work of this project shall be completely and effectively grounded in accordance with all Code and Standards requirements, whether or not such connections are specifically shown or specified.

C. Resistance:

1. Resistance from the farthest ground bus through the ground electrode to earth shall not exceed 5 Ohms or the requirements of ANSI/TIA/-606-B-2012, whichever is more restrictive.
2. Resistance from Electronic Safety and Security Rack Buss ground to Ufer ground must remain less than or equal to the electrical ground presented at A/C outlet for electronic equipment in the communications rack.

1.4 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI/TIA/-606-B-2012, Administration Standard Telecommunications Infrastructure.

2. ANSI-J-STD-607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

B. ASTM INTERNATIONAL (ASTM)

1. ASTM B3 (2013) Standard Specification for Soft or Annealed Copper Wire

C. IEEE

1. IEEE C135.30 (1988) Standard for Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

2. IEEE 81 (2012) Guide for Measuring Earth

D. Underwriters Laboratories (UL)

1. UL 467 (1993); R 2004 Grounding and Bonding Equipment

1.5 SUBMITTALS

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

1.6 QUALITY ASSURANCE

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

1.7 DELIVERY, STORAGE AND HANDLING

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

1.8 WARRANTY

A. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:

1. Ground Bushings, Connectors, Jumpers and Bus:
   a. O-Z/Gedney.
   b. Thomas & Betts Corp.
   c. Or equal.
2. Compression Connector Lug
   a. Panduit
   b. Harger Lightning & Grounding
   c. Or equal.
3. Telecommunications Ground Bus Bar
   a. Panduit
   b. Harger Lightning & Grounding
   c. or equal.
4. Rack and Cabinet Grounding
   a. Panduit Structured Ground Kit
   b. Harger Lightning & Grounding
   c. or equal.

2.2 GROUND CONDUCTORS

A. General purpose insulated: UL listed and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green.

B. Cable jacket marking:

1. Must be legible and shall contain the following information:
   a. Manufacturer’s name
   b. Copper conductor gauge
   c. UL listing
   d. Cable jacket shall be green with black lettering

C. Telecommunications Bonding Backbone Cable: 3/0 AWG THHN/THWN CU - Must be UL listed.

1. Manufacturer:

a. General Cable
b. Harger Lightning & Grounding
c. or equal.

D. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provided with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.

E. Bonding Conductors sized at 2 kcmil per linear foot of conductor length up to a size of 3/0 AWG ground wire.

2.3 COMPRESSION CONNECTOR LUG

A. Compression connector lug

1. Description
   a. Long-barrel compression lugs shall be used on all ground wire.
   b. Copper alloy body.
   c. Provide lug size to match conductor being terminated.
   d. Provide 2 hole pattern lugs.
   e. Provide each lug with silicon bronze hardware, including 2 bolts, 2 split lock washers and 2 nuts.
2. Manufacturer:
   a. Panduit
   b. Harger Lightning & Grounding GECLBxxx (xxx depending on Cable Size)
   c. or equal.

2.4 INSULATED GROUNDING BUSHINGS

A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

2.5 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

A. Where required by the Drawings or Specifications, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.

1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Harger Lightning & Grounding, Cadweld, Thermoweld or equal. Each particular type of weld shall use a kit unique to that type of weld.
2. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series, Burndy “Hy-Ground” or equal.

2.6 EXTRA FLEXIBLE, FLAT BONDING JUMPERS

A. Two Hole Tinned Flat Braided Copper Ground Straps, 6 Gauge equivalent, 12" long with crimped lugs on each end and ¼"-20 mounting hardware.

1. Manufacturer:

a. Harger GS12094122C3/8

b. or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide Grounding and Bonding according to the most restrictive requirements of:

1. ANSI-J-STD-607-B

2. California Electrical Code Article 250 and references therein.

3. California Electrical Code Article 800.

B. In the event of conflicting requirements, National Electrical Code requirements shall prevail.

C. Point of Connection

1. Under Work of this Section, ground to the building Telecommunications Grounding System as installed under the work of Division 27 at the TMGB

D. Ground And Bonding Conductor Installation

1. All lug connections to the ground bars and opposite end shall use Antioxidant Joint Compound.

2. Unless otherwise noted, all bonding and ground wires on telecom cable trays and runways shall be routed on the outer edge of the cable trays and runways.

E. Mechanical Connections

1. Make connections bare metal to bare metal.

2. Where required, remove paint to bare metal, make grounding or bonding connection, and touch up paint.

3. Torque threaded fasteners to manufacturer's recommended values.

F. Compression Connections

1. Make compression connections with the lug or fitting manufacturer's recommended tooling, with the tooling set to the recommended force and stroke.

G. Electronic Safety and Security Raceways and Sleeves

1. Bond metallic raceway and sleeves to the Telecommunications Ground Busbar at the Telecommunications Room that serves the related Electronic Safety and Security systems.

2. Where a metallic raceway connects 2 or more Telecommunications Rooms, bond to the Telecommunications Ground Busbar at each.

H. Cable Shields

1. Comply with California Electrical Code Article 800.

I. Protector Fields

1. Comply with California Electrical Code Article 800.

J. Electronic Safety and Security cabinets and enclosures

1. Bond to the Communications Ground Busbar at the Communications Room.

3.2 LABELING

A. Provide labeling according to the requirements of:

1. ANSI/TIA/EIA-606-A.

2. Section 28 05 00 – Common Work Results for Electronic Security and Safety.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Electronic security systems pathway requirements are shown schematically on the plans. Work of the Project includes design and provision by the contractor of complete electronic security systems pathways as specified in this Section and as shown diagrammatically on the plans. Design and provide electronic security systems pathways to be in accordance with the California Electric Code, ANSI/TIA-569-C (2012) Telecommunications Pathways and Spaces, as specified in this Section and as shown on the plans, whichever is most restrictive. Provide system furniture pathways in accordance with UL 1286.

B. Contractor to design complete Electronic Safety and Security pathway system including provision of the following

1. Rigid steel conduit and fittings.
2. Intermediate metal conduit and fittings.
3. Electrical metallic tubing and fittings.
4. Non-metallic raceway and fittings.
5. Flexible metallic conduit and fittings.
6. Liquidtight flexible metallic conduit and fittings.
7. Miscellaneous conduit fittings and products.
8. Junction Boxes
9. Hinged cover enclosures.
10. Pullboxes and Terminal Cabinets.
11. Wireway
12. Strut supports
13. Beam clamps
14. Concrete Fasteners
15. Touch-Up Materials
16. Conduit supports.
17. Equipment supports.
18. Fastening hardware

C. Provide fire penetration sealant systems at all rated wall and floor/ceiling penetrations as required. Additionally, provide where indicated, which may be in excess of Code but required to meet College's operational and functional requirements.

D. At Hazardous Occupancies, installation conforms to the requirements of California Electric Code for Class and Division rating of spaces.

E. Fastening System Description

19. Provide devices specified in this Section and related Sections for support of electronic safety equipment specified for this Project.

20. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

21. Seismic Design Requirements

a. Identify each item requiring seismic restraint installation in accordance with CBC Chapter 16. Include floor mounted items weighing more than 400 pounds and wall mounted or suspended items weighing more than 20 pounds.

b. Supports for such items, including racks, conduit, cable trays and similar shall be provided support, bracing, and anchorage, designed by the Contractor in accordance with the following criteria:
1) Design to resist seismic forces in accordance with CBC Chapter 16.
2) Minimum Design Parameters - As defined for the Building, with respect to Occupancy Category, Site Classification, Seismic Design Category, Importance Factor, Spectral Acceleration and SDI.

1.2 RELATED DOCUMENTS

F. Drawings and general provisions of the Contract, including Conditions and Division 1 Specification Sections, apply to this Section.

G. Related Work In Other Sections. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1. Section 01 73 00 – Execution Requirements
2. Section 01 73 29 – Cutting and Patching
3. Section 28 05 00 – Common Work Results for Electronic Safety and Security
4. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
5. Section 28 05 26 – Grounding and Bonding for Electronic Safety and Security

1.3 REFERENCES

H. Usage: In accordance with Section 01 42 00 – References.

1. American Institute Of Steel Construction (AISC)
   a. AISC 325 (2005) Steel Construction Manual
2. American National Standards Institute (ANSI)
   a. ANSI C80.1 1994 Rigid Steel Conduit - Zinc Coated
   b. ANSI C80.3 1991 Electrical Metallic Tubing - Zinc Coated
3. American Society For Testing and Materials (ASTM)
   a. ASTM A123/A123M-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   b. ASTM A153/A153M-04 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   c. ASTM B633-98e1 Specification for Electro-deposited Coatings of Zinc on Iron and Steel.
   d. ASTM A653/A653M-04a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. National Electrical Manufacturers Association (NEMA)
   a. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)
   b. NEMA FB 1 (ANSI/NEMA FB 1-2003) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
   c. FB 2.10 2000 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).
   d. FB 2.20 2000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
   e. NEMA ICS 6 1988 (Rev. 1) Enclosures for Industrial Control and Systems
   f. NEMA OS 3-2002 Selection and Installation Guidelines for Electrical Outlet Boxes.
   g. NEMA RN 1-1998 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   h. NEMA TC 7 2000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct
   i. NEMA TC 13 2000 Electrical Nonmetallic Tubing (ENT).
   j. NEMA TC 14 1984(R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
5. Underwriters Laboratories, Inc. (UL)
   a. UL 1 2000 Flexible Metal Conduit
   b. UL 6 2004 Electrical Rigid Metal Conduit - Steel
   c. UL 50 (1995; R 1999, Bul. 2001) Enclosures for Electrical Equipment
   d. UL 360 1986 (Bul. 1991) (R 1993) Liquid-Tight Flexible Steel Conduit

e. UL 514A 1991 (R 2004) Metallic Outlet Boxes

f. UL 514B 1989 (R 2004) Conduit, Tubing and Cable Fittings

g. UL 514C 1996 (R 2000) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.

h. UL 651 1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit.

i. UL 797 1993 (R 2004) Electrical Metallic Tubing - Steel

j. UL 1242 1983 (R1993) (Bul. 1993) Intermediate Metal Conduit.

k. UL 1286(1999; R 2001, Bul. 2002) Office Furnishings

l. UL 1479 Fire Tests of Through Penetration Firestops

m. UL Fire Resistance Directories

1.4 SUBMITTALS

I. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification, Section 28 05 00 - Common Work Results for Electronic Safety and Security and the following:

1. As part of the project submittals, the contractor to provide engineered shop drawings indicating the proposed design for mounting all work of this Division as defined under the Seismic Design Requirements and defined elsewhere in this Section, inclusive of mounting systems, equipment mounted at the exterior, inclusive of its effective wind load under the range of conditions expected.

a. Shop drawings to be accompanied by anchorage calculations indicating that it shall remain attached to the mounting surface after experiencing forces in conformance with California Code of Regulations, Title 24, California Building Code.

b. Structural Calculations shall be prepared and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.

1.5 QUALITY ASSURANCE

J. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

K. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.

L. Only products and applications listed in this Section may be used on the project unless otherwise submitted and approved by the College's Representative.

1.6 DELIVERY, STORAGE AND HANDLING

M. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

1.7 WARRANTY

N. Conform with the requirements of Conditions of Construction Contract, Division 1 Specification and Section 28 05 00 - Common Work Results for Electronic Safety and Security.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MATERIALS

A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.

2.2 GENERAL

B. Provide the following types of conduit systems listed by their commonly used generic name.

2.3 RACEWAY

C. Manufacturers:

1. Raceway:
    a. Allied Tube and Conduit Co.
    b. Triangle PWC, Inc.
    c. Western Tube and Conduit Corp.
    d. Spring City Electrical Manufacturing Co.
    e. Occidental Coating Co. (OCAL).
    f. Alflex Corp.
    g. American Flexible Metal Conduit Co.
    h. Anaconda.
    i. Or equal.
2. Stainless Steel Raceway and Fittings
    a. Calbrite

b. Allied Tube and Conduit

c. Or equal.

3. Fittings:

a. Appleton Electric Co.

b. OZ/Gedney.

c. Thomas & Betts Corp.

d. Spring City Electrical Manufacturing Co.

e. Occidental Coating Co. (OCAL).

f. Carlon.

g. or equal.

D. Rigid Steel Conduit.

4. Drawing and Spec Reference: RSC.

5. Construction:

a. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.

b. Compression type couplings, locknuts, bushings, and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure.

c. Three piece couplings: Electroplated, cast malleable iron.

d. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150 degree C minimum.

e. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.

f. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150 degrees C.

g. All fittings and connectors shall be threaded.

E. Coated Rigid Steel Conduit:

6. Drawing and Spec Reference: CRSC.

7. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.

8. Fittings:

a. Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory PVC coated with an insulating jacket equivalent to that of the coated material.

b. Fittings over-sleeve to extend 1 conduit diameter or 1-1/2" beyond fitting, whichever is less.

9. Performance:

a. Tensile Strength: 3500 psi.

10. Approvals:

a. NEMA RN1 (Type 40 - 40 mils thick)

b. CalTrans Type 2

11. Manufacturers:

a. Plastibond by RobRoy Industries.

b. Occal-40 by Occidental Coating Company.

c. KorKap by Plastic Applicators.

d. Ocal-Blue

e. or equal.

F. Intermediate Metal Conduit

12. Drawing Reference: IMC

13. Conduit: Hot dip galvanized steel meeting the requirements of CEC Article 345 and conforming to ANSI C80.6 and UL 1242.

14. Fittings: Compression type couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.

G. Electrical Metallic Tubing.

15. Drawing and Spec Reference: EMT.

16. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 specifications and shall meet UL classifications.

17. Raintight compression couplings: Electroplate steel or cast malleable iron; UL listed raintight and concrete tight, using gland and ring compression type construction.

18. Raintight compression connectors: Electroplated steel or cast malleable iron, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.

19. Use of set-screw couplings and connectors is not permitted.

H. Flexible Conduit:

20. Drawing Reference: FLEX

21. Construction:
    a. Flexible steel, zinc coated on both inside and outside by hot-dipping process.
    b. Interlocking spirally wound continuous steel strip.
    c. 3/4" minimum size.
22. Fittings: Compression type connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Exception: Pressure cast screw-in connectors shall be acceptable for fixture connection in suspended ceilings and cut-in outlet boxes within existing furred walls.
23. Approvals:
    a. UL 1

I. Liquidtight Flexible Metallic Conduit

24. Drawing Reference: Liquidtight
25. Conduit: Shall be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquidtight jacket of polyvinyl chloride (PVC) and conforming to UL 360. Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.
26. Fittings: Compression type connector body and gland nut shall be of cadmium plated steel or cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "O" ring gasket recessed into the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

J. Conduit, Stainless Steel

27. Constructed of Type 316 Stainless Steel with either EMT, IMC type stainless steel fittings.
28. Approvals
    a. UL6A

K. PVC Conduit

29. Drawing and Spec Reference: PVC.
30. Construction:
    a. 4" trade diameter, unless otherwise noted.
    b. Poly-vinyl chloride.
    c. Schedule by Application
        1) Straight segments, Schedule 40.
        2) Flat elbows, Schedule 40.
        3) Vertical elbows sweep up to grade, Schedule 80.
        4) Above grade, Schedule 80.
    d. Elbows.

1) Where innerduct liner is scheduled – CRSC.
2) Elsewhere, Schedule 80.
3) 90° C rated.
4) Solvent welded joints, joints by pipe manufacturer.

e. Application.
1) Soil Backfill/Direct Burial
a) RUS Type II, Type C or Type DB
b) Schedule 40.
2) Concrete Encasement:
a) PVC Type DB-120,
b) RUS Type I, Type B or Type EB
c) Any meeting Soil Backfill/Direct Burial.
3) Boring
a) HDPE.
b) RUS Type Flexible Plastic.

f. Performance:
1) Tensile Strength: 7,000 psi at 73.4° F.
2) Flexural Strength: 11,000 psi.
3) Compressive Strength: 8,600 psi.

g. Approvals:
1) RUS Listed for Telephone Cable Installation 5-99 Edition, or latest release thereof.
2) NEMA TC-2, PVC Type EPC-40 and EPC-80.
3) NEMA TC-3.
4) NEMA TC14 Fiberglass Conduit.
5) UL 514 fittings.
6) UL 651.
7) ANSI C33.91.

h. Manufacturers:
1) RUS Listed:

Manufacturer	RUS Listed for	Manufacturer Part Number
Allwire, Inc.	Flexible plastic	ALLDUCT
American Pipe & Plastics	Plastic	Type B, C, and D
	Plastic	Type EB and DB
	Plastic	PVC Multi-Duct (2,3,4 and 6-way)
Americon International	Flexible plastic	HDPE Duct
	Plastic	PVC Type C
Apache Plastics, Inc.	Plastic	Type EB and Type DB
ARMCO	Plastic	Smooth-Cor Type B and Type C
Arnco	Flexible plastic	HDPE Conduit
Bay Plastics, Inc.	Plastic	Type B and Type C
Bristolpipe	Plastic	Type B, C, and D
	Plastic	Type EB and Type DB
Can-Tex	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D

Carlon	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
	Plastic	Multi-Gard
Certain-Teed Products Corp.	Plastic	Type EB and Type DB
CIBA-GEIGY	Fiberglass	T & D Conduit
Condux International, Inc.	Concrete	Condux
	Plastic	Type EB and Type DB
CSR Polypipe	Flexible plastic	HDPE Duct
Dura-line	Flexible plastic	HDPE Duct
Eagle Pacific Industries, Inc.	Plastic	Type EB and Type DB
	Flexible plastic	HDPE Coiled Duct
Endot Industries	Flexible plastic	HDPE Duct
Freedom Plastics, Inc.	Plastic	Type C
Hercules, Inc.	Flexible plastic	Corflo plastic conduit
Hurlbut Plastic Pipe	Plastic	Type C
Ingomar Plastic Pipe	Plastic	Type B and Type C
J-M Manufacturing Company	Plastic	Types C, EB, and DB
Kyova	Plastic	Type EB and Type DB
LCP National Plastics, Inc.	Plastic	Type EB and Type DB
	Plastic	Type B and Type C
Northern Pipe Products	Plastic	Type B, C, and D
OMNI	Flexible plastic	HDPE Duct
Petroflex	Flexible plastic	HDPE Duct
	Flexible plastic	Corrugated HDPE Duct
Phillips Products Co., Inc.	Flexible plastic	Driscon 3200
Phone Ducs	Plastic	Multiple plastic conduit (4, 6, & 9 Way)
PLEXCO	Flexible plastic	PLEXCO Duct
PWPipe	Plastic	Type EB and Type DB
Pyramid Industries, Inc.	Plastic	Type EB and Type DM
	Flexible plastic	HDPE Conduit
Quail Plastics	Plastic	Type EB and Type DB
Queen City Plastics	Plastic	Type EB and Type DB
River City Plastics	Plastic	Type EB and Type DB
Sedco	Plastic	Type EB and Type DB
Southern Pipe, Inc.	Plastic	PVC Types EB, DB, and Sch. 40
Tamaqua Cable Products	Flexible plastic	HDPE Duct
Tridyn Industries	Plastic	Type EB and Type DB
Vassallo Industries	Plastic	Type B and Type C
Wesflex	Flexible plastic	Flex-Con

2) or equal

L. Fiberglass Conduit

31. Drawing Reference: Fiberglass

32. Construction:

a. Trade Standard Sizes

b. Meets NEMA TC 14

c. Complete system of joints and threaded steel conduit couplers

33. Manufacturers:

a. TVC Communication/Vikimatic Fiberglass Conduit

b. Champion Fiberglass

c. FRE Composite

d. or equal.

2.4 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

M. General

1. UL 514B.

2. Listed in UL Electrical Construction Materials List.

N. Conduit Fittings, Insulated Throat Grounding Bushings

3. Description

a. Threaded for Rigid Steel Conduit and Intermediate Metal Conduit.

b. UL Listed for use with copper conductors.

c. Thermoplastic insulated liner for 105 degrees Celsius.

d. Body of malleable iron, zinc plated; or die cast zinc.

4. Manufacturer

a. Thomas & Betts (Steel City) BG-801 Series

b. O-Z/Gedney

c. or equal.

O. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.

P. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.

Q. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.

R. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514.

5. Manufacturer:
    a. OZ/Gedney Type DX
    b. Steel City Type EDF
    c. or equal.

S. Fire rated penetration seals:

6. UL classified.

7. Conduit penetrations in fire rated separation shall be sealed with a UL classified assembly consisting of fill, void or cavity materials.

8. The fire rated sealant material shall be the product best suited for each type of penetration, and may be a caulk, putty, composite sheet or wrap/strip.

9. Penetrations of rated floors shall be sealed with an assembly having both F and T ratings at least equal to rating of the floor.

10. Penetrations of rated walls shall be sealed with an assembly having an F rating at least equal to the rating of the wall.

T. Standard products not herein specified:

11. Submit for review a listing of standard electrical conduit hardware and fittings not herein specified prior to use or installation, i.e. locknuts, bushings, etc.

12. Listing shall include manufacturers name, part numbers, and a written description of the item indicating type of material and construction.

13. Miscellaneous components shall be equal in quality, material, and construction to similar items herein specified.

U. Hazardous area fittings: UL listed for the application.

2.5 JUNCTION AND DEVICE BOXES

V. Junction and Device Boxes

1. Drawing References: As shown on Symbol Schedule
2. Construction:
   a. Concealed/Flush Mounted:
   b. One or two piece welded knockout boxes. Junction boxes with knockouts are not to be used for surface mounted locations or exposed locations.
   c. UL 514A, cadmium or zinc-coated 1.25 oz/sq. ft., if ferrous metal.
   d. Pressed sheet steel, for flush indoor locations.
   e. UL 514C approved if non-metallic.
   f. At hollow masonry, tile walls and plaster walls, provide with device rings as required.
   g. Surface mounted:
      1) Conform to the Junction and/or PullBox construction scheduled on the Plans. Where construction not otherwise scheduled or noted on the plans, conform to the following.:
         a) Cast iron with threaded hubs and mounting lugs.
         b) Gasketed cover with spring lid.
      2) Concrete floor embedded:
         a) Cast iron concrete pour boxes with screwed brass cover, unless otherwise noted.
         b) Cadmium plated screw cover attachment at least 6" on center.
   h. If size not otherwise noted, at least 4S (4" square) by 2-1/8" deep, or Code minimum size, whichever is larger.
      1) Wherever 4S is indicated, contractor may at their option substitute 4-11/16" or 5” (5S) square boxes while maintaining the minimum depth required by these specifications and the drawings.
      2) At recessed masonry wall installations, provide gangable masonry boxes.
   i. Provide complete with approved type of connectors and required accessories, including attachment lugs or hangers. Provide raised device covers as required to accept scheduled device.
3. Approvals.
   a. UL 514A
4. Manufacturers:
   a. Interior, flush:
      1) Steel City.
      2) Bowers
      3) Randl Industries, Inc. (5S Boxes).
      4) or equal.

b. Interior, flush 5S Boxes
   1) Randl, Inc. 5 Square Telecommunications Boxes
   2) or equal.

c. Surface mount or exterior, exposed with cover of same construction.
   1) Appleton
   2) Pyle-National
   3) or equal.

d. Other conditions:
   1) Any meeting approvals and requirements.

2.6 TERMINAL BOXES, PULL CANS AND ENCLOSURES

W. Terminal Cabinets:

1. Drawing Reference: As Scheduled.

2. Construction:

   a. General
      1) Interior dimensions not less than those scheduled.
      2) Door face to be not less than 95% of panel interior dimensions.
      3) Provide with 3/4" fire retardant treated ply backboard where device termination scheduled/required within enclosure

   b. Interior Application

   c. Zinc Coated Sheet Steel, code gauge with standard concentric knockouts for conduit terminations.

   d. Finish: Manufacturer's standard gray baked enamel finish.

   e. Flush mounted enclosure Covers: Trim fitted, continuous hinged steel door, flush catch - lockable and keyed to match. Screw fastened doors not acceptable.

   f. Surface mount cabinets shall be furnished with screw cover trim, flush hinged door and shall not be less than 6 inches deep.

   g. Exterior Applications
      1) Door and lock arrangement as required by manufacturer to maintain specified rating.

3. Mounting:

   a. Flush mount cabinets shall be furnished with concealed trim clamps and shall be not less than 4 inches deep or as scheduled, whichever is greater

4. Approvals

   a. Interior Applications:
      1) NEMA 250 Type 1, unless otherwise noted. Refer to plans and schedules.

   b. Exterior Applications:

1) NEMA 250 Type - As scheduled, not less than NEMA 3R. Provide NEMA 4 and 4X where scheduled or where required to match installation conditions.

5. Manufacturers, Metallic Enclosures:
   a. B-Line Electrical Enclosures
   b. Circle AW Products.
   c. Hammond
   d. Henessey.
   e. Hoffman.
   f. Myers Electric Products
   g. Rittal.
   h. or equal.
6. Manufacturers, Non-metallic Enclosures
   a. Stahlin Enclosures
   b. Cabletek
   c. RMS Electronics, Inc
   d. STI, Inc
   e. Vynckier Inc.
   f. Or equal.

2.7 WIREWAY

X. Lay-In Wireway

1. Drawing Reference: Gutter
2. Features/Functions/Construction
   a. NEMA Type 1, unless otherwise noted.
   b. ANSI 61 Gray polyester powder finish inside and outside.
   c. Screw fastened cover completely removable to provide complete access to interior.
   d. 6"x6" cross-section minimum, size for 30% fill maximum
3. Approvals
   a. UL 870
   b. NEMA Type 1
4. Manufacturers
   a. Hoffman Lay-In Type 1 Wireway

b. Square D

c. Circle AW

d. or equal

2.8 THROUGH PENETRATIONS SEALANT SYSTEMS

Y. At a minimum, follow all manufacturer instructions. In case of discrepancy between manufacturer and contractor requirements, the more stringent shall apply. In the case of conflicting instructions, report any discrepancy to the College's Representative in a timely fashion so as not to impact the construction timeline.

Z. Application: Through Penetration Sealant Assemblies, Renenterable

1. Zero-maintenance firestop assemblies shall be used at all penetrations of rated partitions when the pathway on one or both sides of the wall, ceiling or floor is open, such as J-hooks or cable tray.

2. Communications cable tray or ladder rack shall not be continued through a fire-rated wall. Stop the tray or ladder rack, install multiple zero- maintenance firestop assemblies as needed, and continue the tray or ladder rack on the other side. Ensure grounding of the cable tray is continuous through the wall.

3. Electronic security system conduit sleeves through a single fire-rated wall shall not be used. For these applications, a zero-maintenance firestop assembly is required.

AA. Application: Firestopping for Conduits and Other Closed Pathways

4. Firestopping is required for all fire-rated penetrations where a electronic security system conduit or other closed pathway penetrates one or more membranes of a fire-rated wall floor or ceiling

5. Required for all electronic security system outlets located on fire-rated walls. Systems shall be UL CLIV tested

BB. For all penetrations for electronic security system openings through fire-rated walls, floors and ceilings, install the same manufacturer's product for that type of penetration throughout the project.

CC. Coordinate with all other trades prior to installation:

6. To ensure that through penetration firestop systems are installed according to specified requirements.

7. To ensure that sizing of openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems is appropriate.

DD. All penetrations through fire-rated building structures (walls, ceilings and floors) shall be sealed with an appropriate firestop system that at least matches the fire rating of the structure. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire-rated structure).

8. Any penetrating item i.e., riser slots, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped.

9. Through penetrations shall be sealed on both sides of the structure.

10. Electronic security system outlet back-boxes installed in fire-rated walls shall be completely enclosed in an appropriate firestopping assembly within the wall.

11. Conduit sleeves shall not be used for penetrating fire-rated floors, ceilings and walls. A zero-maintenance firestop assembly shall be used instead.

EE. Verify the locations of all fire-rated walls prior to installation.

FF. Firestopping assemblies must make a gas, smoke and water tight seal when activated in a fire.

GG. Multiple cable bundles planned to penetrate a fire-rated wall and entering the same space within 10 feet of each other shall be consolidated in to a single penetration, unless one or both penetrations are membrane penetrations.

HH. Ambient Conditions:

12. Do not install firestopping products when ambient or substrate temperatures are outside the limitations recommended by the manufacturer.

13. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

14. Maintain the minimum temperature before, during, and for a minimum 3 days after installation of materials.

II. Schedule installation of firestopping after completion of the penetrating item (e.g., conduit) installation but prior to the covering or concealing of openings.

JJ. Before beginning installation:

15. Examine and clean the affected surfaces, as they shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.

16. Provide masking and temporary covering to protect adjacent surfaces.

17. Do not proceed until unsatisfactory conditions have been corrected.

KK. After installation:

18. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

19. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

20. Do not cover installed firestopping assemblies until inspected by the College’s Representative.

LL. All firestop systems (including the cabling through them) and identification labels shall be installed prior to the College Representative's above-ceiling inspection.

MM. Labeling

21. At all firestop locations, install a permanent label near the firestop on each side of the wall, ceiling or floor. Labels shall be pre-printed and include:
    a. Manufacturer of the firestop.
    b. Name of product and UL System Number.
    c. Name of installer and company name
    d. Date of installation.
    e. Rating of the wall/system (F and T ratings).
22. One location may have multiple labels (e.g. for a firestop in the annular space around a conduit penetration and a firestop within the conduit around the cables).
23. Labels shall not be painted over or otherwise obscured or defaced.

2.9 SUPPORTING DEVICES

NN. General

1. Supports to be sized to suit load and selected to match mounting conditions

OO. Manufacturers

2. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
    a. Concrete fasteners:
        1) Phillips "Red-Head".
        2) Remington.
        3) Ramset.
        4) Hilti
        5) Simpson Strong-Tie
        6) or equal.
    b. Concrete inserts and construction channel:
        1) Unistrut Corp.
        2) GS Metals "Globe Strut."
        3) Thomas & Betts "Kindorf" Corp.
        4) Or equal.
    c. Conduit straps:
        1) O-Z/Gedney.
        2) Erico "Caddy" Fastening Products.
        3) Thomas & Betts "Kindorf" Corp.
        4) Or equal.
    d. Beam Clamps

1) Cooper B-Line
2) SuperStrut
3) Unistrut
4) or equal

e. Aircraft Cable Sway Braces
1) Mason Industries
2) M.W. Sausse/Vibrex
3) Loos & Company, Inc.
4) or equal.

PP. Concrete Fasteners

3. Provide expansion-shield type concrete anchors.

4. Provide powder driven concrete fasteners with washers. Obtain approval by College's Representative prior to use.

QQ. Concrete Inserts

5. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of ¼ inch to ½ inch diameter thread for rod support.

RR. Aircraft cable sway braces

6. Steel rope sized to meet load.

SS. Construction Channel:

7. Construction:

a. 1-5/8" square galvanized channel formed from U.S.S.G No. 12 or 0.109 inch cold formed steel with 17/32-inch diameter bolt holes, and 1-1/2 inch on center in the base of the channel.

b. 10 foot sections.

8. All supporting materials by same manufacturer.

TT. Beam Clamps

9. Malleable iron electro-galvanized steel beam clamps selected to match building structural steel members.

UU. Conduit Straps

10. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.

a. Use malleable strap with spacers for exterior and wet locations.

b. Use steel strap without spacers for interior locations.

11. Steel channel conduit strap for support from construction channel.

12. Steel conduit hanger for pendant support with threaded rod

13. Steel wire conduit support strap for support from independent #12 gauge hanger wires.

VV. Threaded rods, couplings, screws and nuts:

14. Electrolytically coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.

WW. Miscellaneous Parts

15. Hot dipped galvanized after fabrication; after cutting, de-burring and hole drilling. Coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.

XX. Paint/Tape for Touch-up:

16. Zinc: CRC "Zinc-It", Glyptal, Enterprise Galvanizing “Galambra”, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. The College’s Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the College.

3.2 EXAMINATION

A. Thoroughly examine site conditions for acceptance of supporting device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.3 PREPARATION

A. Coordinate size, shape and location of concrete pads required for equipment installation with the work of the other trades

B. Lay out support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.

C. Where shown on the Drawings or Specifications, install freestanding Electronic Safety and Security equipment on concrete pads.

3.4 CONDUIT APPLICATION

A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:

1. Exterior, Exposed:
   a. Type RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.
   b. EMT acceptable in all other applications not noted above up to 4" diameter, where used in conjunction with specified Raintight (compression) couplers.
2. Interior, Exposed, Wet and Damp Locations:
   a. Type CRSC.
3. Interior, Hazardous Locations
   a. Type RSC
   b. Type IMC, where permitted by the CEC.
4. Interior, exposed or concealed, dry locations:
   a. RSC, if subject to physical abuse.
   b. EMT, if not subject to physical abuse.
5. Interior, concealed, damp locations, including in masonry walls.
   a. RSC
6. Embedded in Concrete
   a. RSC or rigid non-metallic conduit.
   b. PVC Type Schedule 40.
7. Transition from walls, floor boxes and monuments to open plan furniture systems:
   a. Liquidtight

3.5 GENERAL REQUIREMENTS

A. Refer to the manufacturer's instructions and conform thereto.

B. Distribution Pathway via EMT Raceway:

1. EMT conduit is to be installed meeting the NEC handbook Article 348 Installation Specifications.
2. Provide escutcheon plates for all through wall conduit stubs.
3. All ends of conduits shall be cut square, reamed and fitted with insulated bushing.

4. All conduit which passes through fire walls shall be sealed with fire stop putty after all station wire has been installed.

3.6 MOUNTING AND INSTALLATION – DEVICE BOXES

A. Conform to the more restrictive of NEMA OS 3-2002 and the following.

B. Provide backboxes at all Electronic Safety and Security systems devices. Installation of device plates directly to wall surface without use of a backbox, unless specifically directed on plans, is unacceptable.

C. The distance between pull boxes shall not exceed 150 feet or more than two 90 degree bends.

D. Align boxes plumb with floor and surrounding construction. At door frames, locate 4" from frame. Verify placement with College's Representative details to ensure that box clears all trim, etc.

E. Support and fasten boxes securely. At stud walls use rigid bar hangers, attached to hanger with stud and nut.

F. At existing locations, provide cutting, patching and finishing as required to maintain or restore finishes so that resulting installation is integrated into the Architectural decor of the particular location.

G. Mounting Height: the mounting height of a wall-mounted outlet box is defined as the height from the finished floor to the horizontal center line of the cover plate.

H. Mount outlet boxes with the long axis vertical. Three or more gang boxes shall be mounted with the long axis horizontal.

I. Install wiring jacks and outlet devices only in boxes which are clean; free from excess building materials, dirt, and debris.

J. Install wiring jacks and outlet devices after wiring work is complete.

3.7 TERMINAL CABINETS, JUNCTION BOXES AND PULL BOXES

A. General

1. Thoroughly examine site conditions for acceptance of cabinets and enclosures installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

B. Set cabinets and enclosures plumb and symmetrical with building lines. Furnish and install all construction channel bolts, angles, etc. required to mount all equipment furnished under this Section of the Specifications.

C. Cabinets and enclosures shall be anchored and braced to withstand seismic forces calculated in accordance with standards referenced in Section 27 05 29 – Hangers and Supports for Electronic Safety and Security Systems.

D. "Train" interior wiring, bundle and clamp using specified plastic wire wraps. Separate power and signal wiring.

E. Replace doors or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.

F. Terminate conduit in cabinet with lock nut and grounding bushing.

G. Cleaning

1. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

2. Vacuum clean cabinet on completion of installation.

3.8 SUPPORT

A. Provide supports for raceways as specified in this Section.

B. All raceways installed in exposed dry locations shall be grouped in a like arrangement and supported by means of conduit straps, wall brackets or trapeze hangers in accordance with Code and the requirements of this Section. Fasten all hangers from the building structural system.

C. Provide supports and mounting attachments per the most restrictive of Code and the following Install no more than one coupling or device between supports.

Raceway Size (inches)	No of cables in run	Location	Support Spacing (feet)	
			RSC	EMT
Horizontal Runs				
½, 3/4	1-2	Flat Ceiling Wall Runs	5	5
½, 3/4	1-2	Where Access Limited To Building Structure	7	7
½, 3/4	3≥	Any Location	7	7
1≥	1-2	Flat Ceiling Or Wall	6	6
1≥	1-2	Where Access Limited To Building Structure	10	10
1≥	3≥	Any Locations	10	10
ANY	ANY	Concealed	10	10
Vertical Runs				
½, 3/4	ANY	Exposed	7	7
1, 1-1/4	ANY	Exposed	8	8
1-1/2≥	ANY	Exposed	10	10

D. The College's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the College.

3.9 RACEWAY INSTALLATION

A. General

1. Raceway runs are shown schematically – Contractor to provide design and implementation of complete pathway system. Install concealed unless specifically shown otherwise. Supports, pull boxes, junction boxes and similar generally not indicated. Provide where designated in addition to those required by the Contractor's design.

   a. All raceway in new construction shall be run concealed, unless exposed construction is called for on the plans. Bring to the College Representatives any field conditions requiring exposed electronic security systems pathway and receive direction prior to proceeding.
      1) Conduit entries to device backboxes shall be made from the rear or side where concealed by architectural finish materials and shall not be exposed to public view and/or tampering.

   b. Install exposed conduit and raceway parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours. Level and square conduit and raceway runs.

   c. Raceway runs shall be mechanically and electrically continuous between all each equipment rack and utility demarcation point, receptacle and/or surface raceway strip, as applies.

   d. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box, or outlet by means of a locknut on the outside and a bushing on the inside or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter.

   e. Conduit connections to enclosures will not interfere with components inside enclosure such as batteries, circuit boards, locking mechanisms etc.

   f. Conduit to be connected to enclosures via knockouts from factory. Additional penetrations are not permitted.

   g. Bends
      1) All bends or elbows shall have a minimum radius as follows:

Conduit Size (Inches)	Min. Radius (Inches)
3/4	8
1	12
1-1/4	18
2	24
2-1/2	24
3	30
3-1/2	30
4	30
5	36

2) Use factory elbows or machine bends for conduit bends 1-1/4" and larger.

h. Make bends and offsets so the inside diameter is not effectively reduced. Make bends in parallel or banked runs from the same center line so that the bends are parallel.

i. Install at least one (1) 3/8", 200 pound strength nylon pull cord in all empty raceways.

j. Raceways crossing building expansion joints or in straight runs exceeding 100 feet shall be provided with UL listed expansion fittings.

k. Install conduit seals and drains to prevent accumulated moisture in conduits from entering Electronic Safety and Security Systems enclosures.

2. Do not install conduit in concrete slabs unless specifically directed by College's Representative. Embedded conduits in concrete slab walls, and columns shall be installed in center third between upper and lower layers of reinforcing steel as directed by the College's Representative. Space conduits 8" on center except at cabinet locations where slab thickness shall be increased as directed by the College's Representative.

3. All conduits to be kept 12" away from steam or hot water lines. Install horizontal conduit and raceway runs below water and steam piping.

4. Conduit dropping down to equipment shall be as straight as possible without any offsets, parallel or perpendicular to walls, ceilings and other building features.

5. Conduit installed on any equipment shall be run symmetrical with the equipment and in such a manner as to:

   a. not to be exposed to damage;

   b. not interfere with access to components of the equipment that will interfere with maintenance operation or;

   c. not to be in a manner that the College's Representative deems detrimental to its operation.

6. Whenever an installation such as that listed occurs, the Contractor shall make all necessary changes at no additional cost to the College.

7. All cut ends of conduit, scratches, tool marks, etc. on any metallic raceway installed in the ground or on the exterior of the building shall be treated with two coats of specified Touch Up Paint/Tape.

8. Exposed conduit and metallic surface raceway installed in finished spaces shall be painted to match surrounding surfaces using paint and methods directed by the College's Representative.

9. All raceways stubbing up into equipment or racks shall be sealed. Raceways with conductors shall be plugged with duct-seal. Spare raceways shall be capped. Prevent foreign matter from entering conduit and raceway; use temporary closure protection. Replace conduits containing concrete, varnish or other foreign material.

10. Complete installation of conduit and raceway runs before starting installation of cables/wires within conduit and raceway.

11. Use specified conduit and raceway fittings that are of types compatible with the associated conduit and raceway and suitable for the use and location. Join and terminate conduit and raceway with fittings designed and approved for the purpose of the conduit and raceway system and make up tight.

12. Where chase nipples are used, align the raceway and coupling square to the box and tighten the chase nipple so no threads are exposed.

13. Horizontal conduit or EMT runs, where required and permitted, shall be installed as close to ceiling or ceiling beams as practical.

14. Conduit and EMT connected to wall outlets shall be run in such a manner that they will not cross water, steam or waste pipes or radiator branches.

15. Conduit and EMT shall not be run through beams, purlins or columns except where permission is granted by College's Representative in writing.

16. Bond installed metallic raceway in accordance with the requirements of the CEC.

3.10 RACEWAY FOR ACCESS CONTROL AND INTRUSION DETECTION SYSTEMS

A. Refer to general requirements herein above.

B. Below accessible ceiling line, access control and intrusion detection systems shall be installed in entirely in raceway. Size pathway for 30% fill maximum, including:

1. Rough-in for the field devices as detailed and scheduled on the plans.

2. Surface mounted device boxes, where called for in retrofit conditions, including those intended to mount card readers, local alarm sounders and cameras, to be penetrated from the rear (through the backing construction assembly) to prevent exposing the device to tampering. Surface mount device boxes should be free of knockouts at the sides of the box exposed to public access/view.

3. Pull cabinets located at regular intervals in the building, sized to accommodate the access control and intrusion detection cabling. Locate pull cans outside of public view.

a. Size raceway between pull cabinets to accommodate fill of field devices.

b. Coordinate backbox size to ensure that pathway connections to enclosures shall not interfere with components installed inside enclosure including batteries, circuit boards, locking mechanisms, etc. Undersized enclosures exhibiting interference with installed components to be replaced by the Contractor at no expense to the College.

c. Pathway including flexible metal and armored cable shall terminate in the sensor or device enclosure.

d. Ends of conduit shall be fitted with insulated bushings. Provide continuous complete non-flexible pathways, from device, including pull boxes for all field

devices. Leaving exposed conductors at ends of conduits external to sensors and devices not acceptable except above accessible ceiling line.

4. Gutter at backboard indicated security electronics termination points sized for 30% fill maximum, to terminate the raceway arriving from the pull cabinets and directly from the field devices pathway systems.

5. Mounting field devices to the cover of surface mounted junction boxes is unacceptable and will be replaced at no cost to the College.

C. Steel wireway/gutter and terminal cabinets to be provided at backboards of indicated termination rooms to full enclose the electronic security systems access control and alarm systems wiring, terminal devices, TB15's and terminal blocks used to terminate the field wiring installed under the work of this contract as described elsewhere herein.

3.11 HAZARDOUS LOCATIONS

A. Use rigid steel conduit only.

B. Install UL listed sealing fittings that prevent passage of explosive vapors in accordance with the manufacturers written instructions. Locate fittings at suitable, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank coverplate having a finish similar to that of adjacent plates or surfaces.

C. Install raceway sealing fittings at the following points and elsewhere as indicated:

1. Where conduits enter or leave hazardous locations.

3.12 REUSE OF EXISTING CONDUIT

A. General

1. Existing conduit is to be used as a pathway only where so shown on the drawings.

2. Prior to beginning work involving the use of an existing conduit, the Contractor shall consult with the College’s Representative in order to establish whether or not the conduit contains active service.

3. If no active service exists within the conduit, all cable is to be removed, and work is to proceed.

4. If active service does exist within the conduit and it has been determined that service needs to be disrupted, then work on that conduit shall not proceed until a schedule of service outage has been established by College’s Representative. Once given direction to proceed, the Contractor shall within the time period of one (1) working day; remove the old cable, install, terminate and test the new cables, and notify the College’s Representative the work using the specific conduit has been completed. The College’s Representative shall be responsible for the disconnection and reconnecting of the active service cross-connects within the terminal closet(s).

B. Conduit preparation procedure:

1. Remove existing wires and cables (if any).
2. Run a mandrel ½" smaller than the inside diameter of the conduit through the conduit receiving new wires and cables.
3. If the specified size mandrel will not pass through the existing conduit, start with a smaller size mandrel and increase mandrel size until the specified sized mandrel will pass.
4. Run a wire brush and clean rag with an outside diameter 1/8" larger than the inside of the conduit through the conduit receiving new wires and cables.
5. Repeat above until conduit is clean and materials detrimental to the wire and cables to be installed no longer exit conduit with the clean rag.

3.13 WIREWAY INSTALLATION

A. Install complete wireway system at electronic security systems backboards, including track, cover plate, device boxes, inside and outside elbows, splice plates, T's, transitions and extension rings and end caps as required.

B. Any existing surface raceway and/or exposed cabling along the indicated pathway of the raceway to be installed shall be removed prior to the installation of the new raceway. If the existing cabling contains active service, then Contractor shall consult with the College's Representative as to how best maintain the existing service before proceeding with the work.

C. Provide and install the proper factory fabricated corners, support clips, end connectors, etc. as required.

D. Corners and joints are to be cut neatly and finished using connector components of specified system. Where components are not available using specified system, to meet requirements of drawings, provide cleanly mitered joints, EMT and/or surface backboxes specified elsewhere herein.

E. All installed surface raceway shall be inspected for marks, scratches, gaps between sections or improper fitting of connector parts. All such damage shall be repaired to the College's Representatives satisfaction, or the raceway shall be removed and replaced.

F. Remove sharp corners and edges prior to installation of cable.

G. Attachment of raceway to walls, floors, and partitions:

1. Attach raceway to the supporting surface with mechanical fasteners applied to building structure per the most restrictive of manufacturer's directions, Code, or these provisions.

2. All surface raceway shall be installed so that its edges are parallel to the vertical or horizontal edge of the surface on which they are mounted. All surface raceway, found not to be installed in this manner, shall be removed and re-installed correctly.

3. Surface raceway shall be secured at 2'-0" intervals (2 spaced screws for 2" and wider raceways) with wood screws into wooden framing or self drilling wall anchors (ITWBildex "Heavy Duty E-Z Toggle", no known equal) into sheetrock or plastic inserts with pre-assembled drive screw for concrete (ITT-HOLUB "HI-DRIVE" nail anchors, no known equal) Powder (explosive charge) driven anchors are not acceptable. The use of adhesives as the sole means for fastening to any surface is not allowed.

4. Screws used in fastening surface raceway shall be no less than 3/4" in length.

5. The proper support clips, as called for by the manufacturer, for securing surface raceway to walls or floors are to be used per the manufacturer's instructions.

3.14 PENETRATIONS

A. Gypsum Wall Board Penetrations: Provide circular penetrations maximum 1/8" inch larger than outer diameter of conduit being used. On both sides of the wall fill space between conduit and wall with joint compound, depth to match gypsum board thickness.

B. As specified elsewhere herein, install UL listed fire-stop system whenever a raceway penetrates a firewall in conformance with the manufacturer's directions, the published systems assembly requirements, CBC Section 709 and 710 and CEC 300-21, whichever is the most restrictive. At cable tray penetrations, provide pillow type removable fire stop per CBC Section 709 and 710, the published systems assembly requirements and the manufacturer's directions, whichever is the most restrictive.

C. All Electronic Safety and Security systems conduit openings in walls and floors are the responsibility of the Contractor. Install sleeves shown on the drawings when the concrete is poured. Any openings required after the concrete has set maybe core drilled.

3.15 THROUGH PENETRATIONS SEALANT SYSTEMS

A. At a minimum, follow all manufacturer instructions. In case of discrepancy between manufacturer and contractor requirements, the more stringent shall apply. In the case of conflicting instructions, report any discrepancy to the College's Representative in a timely fashion so as not to impact the construction timeline.

B. Application: Through Penetration Sealant Assemblies, Renenterable

1. Zero-maintenance firestop assemblies shall be used when the pathway on one or both sides of the wall, ceiling or floor is open, such as J-hooks or cable tray.

2. Communications cable tray or ladder rack shall not be continued through a fire-rated wall. Stop the tray or ladder rack, install multiple zero- maintenance firestop assemblies as needed, and continue the tray or ladder rack on the other side. Ensure grounding of the cable tray is continuous through the wall.

3. Electronic security system conduit sleeves through a single fire-rated wall shall not be used. For these applications, a zero-maintenance firestop assembly is required.

C. Application: Firestopping for Conduits and Other Closed Pathways

1. Firestopping is required for all fire-rated penetrations where a electronic security system conduit or other closed pathway penetrates one or more membranes of a fire-rated wall floor or ceiling

2. Required for all teleelectronic security system outlets located on fire-rated walls. Systems shall be UL CLIV tested

D. For all penetrations for electronic security system openings through fire-rated walls, floors and ceilings, install the same manufacturer's product for that type of penetration throughout the project.

E. Coordinate with all other trades prior to installation:

1. To ensure that through penetration firestop systems are installed according to specified requirements.

2. To ensure that sizing of openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems is appropriate.

F. All penetrations through fire-rated building structures (walls, ceilings and floors) shall be sealed with an appropriate firestop system that at least matches the fire rating of the structure. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire-rated structure).

1. Any penetrating item i.e., riser slots, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped.

2. Through penetrations shall be sealed on both sides of the structure.

3. Electronic security system outlet back-boxes installed in fire-rated walls shall be completely enclosed in an appropriate firestopping assembly within the wall.

4. Conduit sleeves shall not be used for penetrating fire-rated floors, ceilings and walls. A zero-maintenance firestop assembly shall be used instead.

G. Verify the locations of all fire-rated walls prior to installation.

H. Firestopping assemblies must make a gas, smoke and water tight seal when activated in a fire.

I. Multiple cable bundles planned to penetrate a fire-rated wall and entering the same space within 10 feet of each other shall be consolidated in to a single penetration, unless one or both penetrations are membrane penetrations.

J. Ambient Conditions:

1. Do not install firestopping products when ambient or substrate temperatures are outside the limitations recommended by the manufacturer.

2. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

3. Maintain the minimum temperature before, during, and for a minimum 3 days after installation of materials.

K. Schedule installation of firestopping after completion of the penetrating item (e.g., conduit) installation but prior to the covering or concealing of openings.

L. Before beginning installation:

1. Examine and clean the affected surfaces, as they shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.

2. Provide masking and temporary covering to protect adjacent surfaces.

3. Do not proceed until unsatisfactory conditions have been corrected.

M. After installation:

1. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

2. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

3. Do not cover installed firestopping assemblies until inspected by the College's Representative.

N. All firestop systems (including the cabling through them) and identification labels shall be installed prior to the College Representative's above-ceiling inspection.

O. Labeling

1. At all firestop locations, install a permanent label near the firestop on each side of the wall, ceiling or floor. Labels shall be pre-printed and include:

a. Manufacturer of the firestop.

b. Name of product and UL System Number.

c. Name of installer and company name

d. Date of installation.

e. Rating of the wall/system (F and T ratings).

2. One location may have multiple labels (e.g. for a firestop in the annular space around a conduit penetration and a firestop within the conduit around the cables).

3. Labels shall not be painted over or otherwise obscured or defaced.

3.16 SUPPORT INSTALLATION

A. Furnish and install supporting devices as noted throughout the Electronic Safety and Security Systems work.

B. Electronic Safety and Security device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.

C. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using powder actuated tools, precast inserts, expansion anchors, preset inserts or beam clamps.

D. Use powder actuated tools, self-drilling anchors, expansion anchor, or preset inserts on concrete surfaces.

E. Use sheet metal screws in sheet metal studs and wood screws in wood construction.

F. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or acoustical ceiling suspension wires.

G. Do not drill structural steel members unless first approved in writing by the College's Representative.

H. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

I. Install surface-mounted cabinets with minimum of four anchors. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.

J. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

3.17 ERECTION OF METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.18 WOOD SUPPORTS

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED WORK IN OTHER SECTIONS:

1. Division 8 – Door Hardware
2. Division 14 - Elevators and Elevator Control.
3. Section 27 15 00 – Communications Horizontal Cabling
   a. Provides the structured cabling to the access control and intrusion detection panels, and biometric readers.
4. Section 28 05 00 – Common Work Results for Electronic Safety and Security
5. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
6. Section 28 05 28 – Pathways for Electronic Safety and Security
7. Section 28 23 00 – Video Surveillance

B. By the College

1. Ethernet Network switches connected to structured cabling installed at the Telecommunications Rooms by Division 27 under the work of this Project.
2. Microsoft Windows ActiveDirectory directory services for use in assigning access groups and users by the Contractor. Refer to the minimum functional directory services capabilities provided by the access control system provided under the work of this Section.

1.3 SCOPE

A. Work of Division 28 includes provision of a Unified Security Platform (USP), including fully integrated access control and video surveillance systems as described in Section 28 23 00 and this Section. Work of section 28 13 00 includes (but is not necessarily limited to) provision of the access control subsystem portion of the USP, including but not limited to:

1. Access Control System.
   a. Work of this Project provides a new enterprise grade access control system with headend server and storage located at the Telecom Rooms in building 1 and 2. The Access Control (ACS) shall include all intelligent field advanced processing controller, communication devices, card readers, combination card readers/keypads, access cards, I/O boards, power supplies, enclosures, mounting hardware, and all other equipment as specified herein. All material shall be the manufacturer's standard catalog products.

b. Monitoring

1) The ACS shall allow system administrators to separate the creation and viewing of objects into partitions. ACS operators shall be associated with partitions and this shall determine which objects operators have the ability to create and or view.

a) The ACS partitions shall include but not be limited to the following objects:

(1) Personnel
(2) Clearances
(3) Doors
(4) Controllers with all associated hardware (readers, inputs, outputs, etc).
(5) Video servers with all associated objects (cameras, tours, views, etc).
(6) Application layouts
(7) Events
(8) Dynamic views
(9) Maps
(10) Reports, forms, results
(11) Holidays
(12) Badge layouts
(13) Queries
(14) Images

b) Graphical User Interface (GUI)

(1) The ACAS shall employ a standard Windows graphical user interface (GUI). A mouse and keyboard shall be the primary operator interface with the system. Operator screens shall utilize all standard Windows-style functions such as drop-down menus, context menus, radio buttons, and lists, as appropriate. The interface shall utilize a 'tree structure' similar to Windows Explorer.

c) Administration Operator Interface

(1) The ACAS shall employ an Administration Operator Interface to control the following:
(2) Hardware (readers, inputs, outputs, door controls, other systems, future fully integrated video surveillance systems,).
(3) Configuration of personnel records, operators and operator privileges.
(4) Graphical Maps.
(5) Application Layouts.
(6) Dynamic Views.
(7) Queries.
(8) Import/Export of objects, including images.
(9) System Variables.
(10) Reports (either periodic or one-time).
(11) System functions (event command and control, actions, schedules).
(12) Display of a list of objects in a grid that can have their values modified and respond to real-time status changes.
(13) Scheduling of backups.
(14) Monitoring of system settings and performance.
(15) Designing of and printing of badges.
(16) The GUI shall be configurable by the system administrator to control the views and access of each Monitoring Station operator.

d) At the workstations, ACS system provides for real time monitoring of system status including graphical maps of the areas under the control of the system indicating alarm conditions correlated with camera call up of the cameras installed under the work of Section 28 23 00 for the cameras with views of the area of alarm as described elsewhere in this Section.
e) System views can be broken into up to 16 tiled focus areas within a single workstation's display to permit simultaneous display of multiple content (example: graphical map, event log, display of user record associated with event, and multiple camera views around event).

2) Workstation and web interface. System permits monitoring of full system feature set from web interface to permit monitoring from a remote sites if required by the College's operations.

c. Input and output points.
1) Work of this project installs new Card Readers at selected door openings as indicated on the plans.
2) Work of this project interfaces the ACS to field devices installed under the work of this Section:
a) Door position switches.
b) Local door alarms
c) Electric locks and electric strikes
d) Request to exit devices, including:
(1) Door hardware with integral REX button functionality.
3) Work of this project interfaces to devices installed under the work of other Sections:
a) Power Door Operators and their controls

2. Intrusion Detection System

a. If the provided ACS system is not listed as a UL Listed 1076 Proprietary Burglar Alarm Unit, provide a separate commercial burglar alarm system consisting of intrusion detection panel and field devices, connected to the surrounding ACS alarm interface using SDK based IP signalling.

1.4 SUBMITTALS

A. Refer to the requirements of Section 28 05 00 – Common Work Results for Electronic Safety and Security.

1.5 TRAINING

A. Train the College's Representatives in operation of the installed video management system. Provide a least three separate training tracks focused on the training needs of specific stakeholder groups within the College's operation and technical staff including at least Operator Staff, Administrators and Colleges Technical/Information Technology Support Staff.

1. For the Operator Staff provide at least eight hour classroom type training sessions, covering the basic theory and operation of the Access Control and Intrusion Detection system and provide up to 20 hours support for the initial systems operator during first use. Schedule the three different sessions at

different times of the day/days of the week to accommodate the different schedules of the College's staff.

2. For the Administrator Staff provide at least eight hours classroom type training in the theory and both basic and advanced operation and functions of the Access Control and Intrusion Detection system. Provide hands-on Training for the Command Center Administrator Staff, provide up to 8 hours hands-on support for in basic and advanced systems operations.

3. For the Colleges Technical/Information Technology Support Staff and third party integrators staff provide eight hours classroom and hands-on training in Access Control and Intrusion Detection system functionality, IP communications protocols used, device handshaking, record importing and overall data flow through the system. Review directory tree integration mechanisms and requirements for tree maintenance. Review methods for bare metal recovery of operations. Review Access Control and Intrusion Detection manufacturer's approved methods for software upgrades and hardware replacement, including failed disks in the storage array.

4. For each Training session, Document the training provided using a camera and video recorder and provide a copy of the recorded training to the College for future reference and use in training new staff.

1.6 QUALITY ASSURANCE

A. General:

1. Conform to Section 28 05 00 - Common Work Results For Electronic Safety and Security.

2. The manufacturers of all hardware and software components employed in the system shall be established vendors to the access control/security monitoring industry for no less than five (5) years.

3. The security system integrator shall have been regularly engaged in the installation and maintenance of integrated access control systems similar in size and scope to that outlined herein for a period of no less than five (5) years. The installing integrator shall be certified by the manufacturer to be able to install and configure the Enterprise version of the manufacturer's access control system.

4. The security system integrator shall supply information attesting to the fact that their firm is an authorized product dealer for the system proposed at the Project site.

5. The security system integrator shall supply information attesting to the fact that their installation and service technicians are competent factory trained personnel capable of maintaining the systems of this scale and of providing reasonable service time.

6. The security system integrator shall provide a minimum of three (3) references whose systems are of similar complexity and have been installed and maintained by the security system integrator in the last five (5) years.

7. There shall be a local representative and factory authorized local service organization that shall carry a complete stock of parts and provide maintenance

for these systems. Local shall be defined as an area in a 50 mile radius of installed location

B. Standards Agencies.

1. The ACS shall be tested and listed by Underwriters Laboratories (UL) for UL 294 for Access Control System Units.

2. Additionally, conform to the applicable portions of the following standards defined in 28 05 00 – Common Work Results for Electronic Safety and Security.

1.7 DEFINITIONS

A. ACS – Access Control System. The integrated system installed by the work of this Contract comprising the access control system, intrusion detection system and panic/duress alarms, including both central processing hardware and the remote field devices.

B. CSA – Client Software Application

C. DGP. Data Gathering Panel. Intelligent access control and alarm systems panel connected to the ACS network and to card readers, access control and intrusion detection field devices as specified elsewhere in this Section.

D. DGM – Dynamic Graphical Maps

E. ALPR – Automatic License Plate Recognition

F. SDK – Software Development Kit

G. SMA – Software Maintenance Agreement

H. SSM – Server Software Module

I. UI – User Interface

J. USP – Unified Security Platform

K. USW – Unified Web Client

L. VMS – Video Management System

1.8 DOOR SEQUENCE OF OPERATIONS.

A. The following outlines the minimum functionality that should be achieved at each opening equipped with card reader control.

B. Assumes doors are in armed condition.

1. Doors with Card Reader on One Side

a. Presentation of valid card at unsecure side:

1) Performs real-time lookup of card against current database to validate card status relative to door opening, day of week and time of day.

2) Provides positive success visual feedback - green light or similar - to card holder
3) Permits cardholder to operate door.
4) Logs entry in access database, including at minimum card number, door number and timestamp
5) Shunts alarm generation for door open status for College selected variable period (adjustable over a range of at least 10 seconds to 1 minute adjustable through ACAS software).
6) If double door opening, permits operation of second leaf during the College selected variable period without generating alarm.

b. Presentation of invalid or unreadable card at unsecure side of door:
1) performs real-time lookup of card against current database to validate card status relative to door opening, day of week and time of day.
2) provides positive failed visual feedback - red light or similar - to card holder and denies operation of door.
3) logs entry in access database, including at minimum card number (if readable), door number and timestamp

c. Approach to door opening from secure side
1) Doors equipped with Request to Exit: If occupant breaks approach beam from side farthest from door first, followed by beams closer to door, shunts generation of alarm on door operation for Construction Administrator selected variable period as for Card Readers above.
2) Doors equipped with Request to Exit equivalent in handle/crash bar: If occupant signals intent to exit from secure side by mechanically operating door hardware, shunts generation of alarm on door operation for College selected variable period as for Card Readers above.
3) Doors equipped with Release Button: On operating Release Button, shunts generation of alarm on door operation for College selected variable period as for Card Readers above.
4) If double door opening, permits operation of second leaf during the College selected variable period without generating alarm.

2. Doors with Card Readers on both sides, one side is secure, one side is unsecure.

a. Operation, General
1) Unless otherwise indicated, doors with dual card readers have an unsecure and secure side. A CR symbol appears on the unsecure side; a CRS symbol appears on the secure side. Neither magnetic locks nor delayed egress systems are to be installed. A valid card is necessary to operate the door from the unsecure side as for doors with single card readers
2) A valid card is necessary to shunt the door alarm when operating the door from the secure side. Failure to present a valid card does not prevent door from operating.

b. Presentation of valid card at unsecure side:
1) performs realtime lookup of card against current database to validate card status relative to door opening, day of week and time of day.
2) provides positive success visual feedback - green light or similar - to card holder
3) permits cardholder to operate door.

4) logs entry in access database, including at minimum card number, door number and timestamp
5) shunts alarm generation for door open status for College selected variable period (adjustable over a range of at least 10 seconds to 1 minute).
6) If double door opening, permits operation of second leaf during the College selected variable period without generating alarm.

c. Presentation of invalid or unreadable card at either side of door:
1) performs real-time lookup of card against current database to validate card status relative to door opening, day of week and time of day.
2) provides positive failed visual feedback - red light or similar - to card holder and, at unsecure side, denies operation of door
3) logs entry in access database, including at minimum card number (if readable), door number and timestamp

d. Presentation of valid card at secure side.
1) performs realtime lookup of card against current database to validate card status relative to door opening, day of week and time of day.
2) provides positive success visual feedback - green light or similar - to card holder
3) logs entry in access database, including at minimum card number, door number and timestamp
4) shunts alarm generation for door open status for College selected variable period (adjustable over a range of at least 10 seconds to 1 minute).
5) If double door opening, permits operation of second leaf during the College selected variable period without generating alarm.

3. Doors with Card Readers on both sides, both sides unsecure.

a. Operation, General
1) Where indicated by CR symbols on both sides of the door, the door opening to require a valid card to operate the door from either side.
2) Such door configurations shall not be installed where the door is part of an emergency egress path of travel.

b. Presentation of a valid card at either side:
1) performs realtime lookup of card against current database to validate card status relative to door opening, day of week and time of day.
2) provides positive success visual feedback - green light or similar - to card holder
3) permits cardholder to operate door.
4) logs entry in access database, including at minimum card number, door number and timestamp
5) shunts alarm generation for door open status for College selected variable period (adjustable over a range of at least 10 seconds to 1 minute).
6) If double door opening, permits operation of second leaf during the College selected variable period without generating alarm.

c. Presentation of invalid or unreadable card at either side of door:
1) performs real-time lookup of card against current database to validate card status relative to door opening, day of week and time of day.

2) provides positive failed visual feedback - red light or similar - to card holder and denies operation of door
3) logs entry in access database, including at minimum card number (if readable), door number and timestamp

4. Doors left open ("propped open") beyond the designated period generate an alarm at the central control panel indicating door and condition. If a local door alarm is shown in the vicinity of the door, causes the local door alarm to sound. Local alarms for door prop should provide an intermittent tone 30 seconds before going into alarm and triggering a solid tone upon alarm. Local door alarm can be cleared either from the access control system control screen or locally using designated key. Use of a key to silence the LA sounding, but shall not interrupt processing of other ACS events associated with event.

5. Doors operated while armed without presentation of a valid card, valid operation of a Request to Exit Device, operation of a release button or release by central control panel to generate an alarm at the central control panel indicating door and condition. If a local door alarm is shown in the vicinity of the door, causes the local door alarm to sound, Local door alarm can be cleared either from the access control system control screen or locally using designated key.

6. Doors provided with powered door operators to be configured to operate as follows:

a. Unsecure side
1) Depressing the door operator button without first presenting a valid card results and no action.
2) Depressing door operator button after presenting a valid card causes the DGP to signal the door operator to initiate door opening after the associated electric lock mechanism has been released.
a) In a double door, where the handle in an electric latch cannot be retracted remotely, this may include releasing an electric strike in the normally passive leaf of the opening.
b) College's Representative to provide direction as to the length of time for which the door operator button to remain operational following receipt of a valid card.

b. Secure side
1) Depressing door operator button causes the DGP to signal the door operator to initiate door opening after the associated electric lock mechanism has been released.
a) In a double door, where the handle in an electric latch cannot be retracted remotely, this may include releasing an electric strike in the normally passive leaf of the opening.

C. Gate Operation

1. Presentation of valid card or vehicle emitter at unsecure side:

a. performs real-time lookup of card against current database to validate card status relative to gate, day of week and time of day.

b. provides positive success visual feedback - green light or similar - to card holder.

c. signals gate controller to operate gate.

d. logs entry in access database, including at minimum card number, door number and timestamp

e. shunts alarm generation for gate open status for College's Representative selected variable period (adjustable over a range of at least 30 seconds to 2 minutes).

2. Presentation of invalid or unreadable card at unsecure side of gate:

a. performs real-time lookup of card against current database to validate card status relative to gate, day of week and time of day.

b. provides positive failed visual feedback - red light or similar - to card holder and denies operation of gate logs entry in access database, including at minimum card number (if readable), door number and timestamp

3. Approach to gate from secure side

a. detector loop or similar device detects presence of vehicle at exit point.

b. receives signal from gate operator on action to operate Gate.

c. shunts alarm generation for gate open status for College's Representative selected variable period (adjustable over a range of at least 30 seconds to 2 minutes).

4. Detects forced operation of gate/operation of gate without use of valid card, remote release by Controller or in response to inductive loop detector or its functional equivalent.

a. generates an alarm at the central control panel indicating gate location and condition

D. Tamper Monitoring

1. Tampering with the DGP (removing its cover panel) or of other monitored electronic security system pullbox covers to be reported to the central ACS monitoring station. Restoral events (replacement of cover) to similarly be reported to the central ACS monitoring station.

1.9 COORDINATION

A. Coordinate the work of this contract with the related work of at least the following parties:

1. College’s Physical Security Staff

2. College’s IT staff and the IT Integrators working for the College

PART 2 - PRODUCTS

2.1 ELECTRONIC ACCESS CONTROL SYSTEM

A. Authorized Manufacturer(s): Schlage (District Standard, No Substitution Allowed)

1. Software: Pure Access ™ Cloud

2. Hardware:

a. IP Reader Controller

b. IP Bridge

B. Description:

1. Provide a complete and operational access control system (ACS) as indicated in the drawings and plans, including but not limited to an ACS Cloud Service Host, IP based Reader-Controllers and/or IP-Bridges connected by a high-speed electronic data transmission network.

   a. The Cloud Service shall be host on Amazon Web Services and provide for a minimum of 99.95% uptime. The Manufacturer shall closely monitor all conditions related to the Cloud Service infrastructure.

   b. The network connecting the ACS Cloud Service Host, IP Bridge and IP based Reader-Controllers shall be a Local Area Network (LAN) or Wide Area Network (WAN) utilizing TCP/IP communications protocol.

   c. Functions- The systems primary functions shall include
      1) Regulating access through doors, gates, turnstiles, and other entrance portals
      2) Credential cards and readers
      3) Credential creation and credential holder database and management
      4) Monitoring of field-installed devices
      5) Reporting

   d. Third Party Devices- In addition to supporting the Manufacturer's own multi-card readers, the system shall support the following types of readers by utilization of an IP Bridge:
      1) Wiegand output devices including but not limited to:
         a) Biometric devices
         b) Long Range Readers such as Tagmaster
         c) Barcode scanners

2. System Software:

   a. The ACS Host application software shall provide the interface between the Client, IP-Bridges, IP based Reader-Controllers, report alarms, generate reports and provide all other system functions.

   b. The system shall provide a web based User Interface using standard browsers such as Chrome, Firefox and Microsoft Edge. Mobile devices such as tablets and smart phones will be able to log in via the same such browsers and have a User Interface optimized for mobile experience.

   c. The system software license shall be licensed as follows:
      1) ACS Cloud Service:
         a) License shall be provided for the desired number of access points and users.
         b) b. Shall be an annual fee paid to maintain the Cloud Service and provide regular updates.

   d. System Functions - The access control system software functions shall include the following:
      1) User/Credential Management

a) Number of users and credentials dependent upon license limitations.
b) User group functionality
c) Users configuration shall have the following attributes:

(1) First name, mddle initial, and last name.
(2) User Image
(3) Alert email address for the User to receive Alert emails
(4) Ten (10) customizable User Defined Fields
(5) Web Access with customizable User Roles to define what the User can view and edit in the Client. Passwords for Web Access shall be forced to use strong passwords.
(6) Can reside in an unlimited number of User Groups.
(7) Can be associated with Custom Rules

2) When deactivating a User, the system shall deactivate all associated credentials with that User. Any credential can be deactivated without deactivating the associated User.
3) Microsoft Point Programming and Management
   a) System shall allow for the integration to Microsoft Active Directory unless it is utilizing a Cloud Service license of under fifty (50) Access points. This Integration will synchronize Users from Active Directory to the ACS Host. The ACS Host will poll the Active Directory server regularly for changes and synchronize those changes to its database.
4) Access Point Programming and Management:
   a) Provide an easy to use wizard to add Access points to the software
   b) Wizard shall include a full test of all Access Point components
   c) Configurable door latch interval
   d) Input enable/disable and configuration
   e) Number of Access Point Groups - Unlimited
5) Weekly Schedules:
   a) Number of Weekly Schedules - Unlimited
   b) Interval assignments - Any day of the week
6) Weekly Rules configurable based on type of device being used
7) Alarm and Event Logging - provide for logging of all system alarms and events chronologically including time and date stamp. Specific alarm conditions monitored shall be included but not limited to:
   a) Door Unauthorized Open Alarm
   b) Door Extended Open Alarm
   c) Reader-Controller Tamper Alarm
   d) Device Offline Alert
8) System Scheduling - provide for scheduling of events including:
   a) Access Point or Access Point Group unlock for specified Schedule.
   b) Access Point or Access Point Group unlock with specified Badge(s), Access Point(s) shall remain locked until an authorized Credential is read.
9) System Dashboards- Monitoring Attributes
   a) Shall provide customizable Dashboards for Monitoring of the ACS. These Dashboards shall be fully customizable, able to filter on all

events, able to filter on all devices where applicable and include the following:

(1) Ability to display non-wireless single Access Point status with the following:

(2) Live update of door status including physical door status and all event history on devices connected in real-time.

C. IP Reader Controller

1. Features/Functions

a. The Schlage RC contains 125 kHz proximity, 13.56 MHz smart and 2.4 GHz Bluetooth circuitry enabling the ability to process multiple formats simultaneously.

b. Real time connectivity; local mode feature allows readers to function without a connection to the network results in faster user response times, less network traffic and reduced host system loading.

c. Tamper detection via accelerometer senses any type of altering and prevents a security breach with the reader.

d. Communication is secured using industry standard TLS 1.2 encryption

e. Commission via ENGAGE™ mobile app for easy configuration

f. Three configurable inputs; Door Position (DPS), Request to Exit (REX),

g. and Auxiliary (AUX)

h. Mullion, wall mount and wall mount with keypad form factors

i. Reader controllers support 125 kHZ proximity, 13.56 MHz smart technology, 2.4 GHz Bluetooth and Near Field Communication (NFC)

j. Credential parity standard with Schlage MTB mobile enabled multi-technology readers and Schlage mobile enabled wireless locks; ISONAS credential parity is a factory orderable option

k. Accommodates interior, exterior, metal and non-metal installation environments

2. Operations/Performance

a. Reader type IP reader controller

b. Mounting style Mullion and Single gang

c. Standards ISO 14443A, ISO 15693

d. Certifications
1) FCC Certification
2) IC Certification
3) UL294 V7 / cUL Listed
4) RED Directive
5) CE Mark
6) IP65
7) REACH
8) Bluetooth SIG
9) RoHS 3

e. Frequency
   1) 2.4 GHz
   2) 13.56 MHz
   3) 125 kHz

f. Intelligence capacity
   1) 64,000 credentials
   2) 5,000 events
   3) 32 time schedules
   4) 32 holidays

g. Network communications
   1) 10/100Mb, half or full duplex
   2) Ethernet, WebSockets, standard Cat5E or better cable
   3) Network host or client modes - DHCP addressing

h. Visual communications LED (red, amber, green)

i. Audible communications Audible indicator (on / off)

j. Software compatibility
   1) Works with open PACS systems including ISONAS Pure AccessTM Cloud.

k. FIPS 201 compliant No

l. Technology supported
   1) CSN1, Proximity,
   2) Smart,
   3) Mobile (NFC and Bluetooth)

3. Manufacturer

   a. Isonas/Schlage
      1) RC11 Mullion Mount
      2) RC15 Single Gang

2.2 ACS SERVER HARDWARE

A. Server Hardware

1. Spec References:

   a. Access Control Server

2. Minimum Features/Functions/Performance

   a. The ACS Server to be compatible and approved for use with and supplied with one of the ACS Manufacturers' Operating Systems supported by the ACS Manufacturer when used as a server device, and with memory, processor and disk space scaled according to the system application requirements of this Project

   b. The server shall be a rack mount standard manufactured product of a computer manufacturer regularly engaged in the production of business class servers and shall carry the manufacturer's standard product warranty, assigned to the College.

c. Server shall meet or exceed the ACS manufacturer's minimum performance and functional requirements for a ACS server at the time of beneficial occupancy.

d. Provide complete system including server, rack monitor, rack mount keyboard and mouse, or provide KVM and share peripherals with other similar rack mount devices installed under the work this Project.

3. Manufacturers:

a. Server
   1) Dell
   2) HP
   3) Intel
   4) or equal.

b. Manufacturer, Monitor:
   1) Samsung series
   2) Sharp
   3) or equal.

c. Rack Mount Monitor Enclosure
   1) Middle Atlantic RSH4A with backclamp.
   2) Raxxess.
   3) Custom by Contractor.
   4) or equal.

d. Combination Monitor with Integral Rackmount, subject to the video response rate requirements defined above.
   1) Tripplite
   2) Marshall Electronics
   3) Pelco
   4) ToteVision
   5) or equal.

2.3 ACCESS CONTROL SENSORS & FIELD DEVICES

A. General

1. Field devices to be selected to match condition of opening and/or space to be protected. The following specifications are minimum standards; Contractor to consult with listed manufacturers and select appropriate device and mounting means for unusual construction conditions.

B. Door Tamper Alarm Switch

1. Drawing Reference: DS

2. Construction and Features

a. UL Listed

b. Hermetically sealed magnetic reed switch. Dual biased high security switch assembly deters tampering. Reed shall be potted in the contact housing with a polyurethane based compound.

c. Magnet shall be made of Alnico V.

d. Steel Door Switches
   1) Contact and magnet housing shall snap-lock into a 1" dia. hole. Snap-lock insulation bushing for tight fit and maximum gap in steel.
   2) Housings shall be molded of flame retardant ABS plastic. Both contact and magnet plastic housings are constructed of one piece of thick-walled ABS plastic for maximum strength.
   3) Color of housings shall be off-white, grey or mahogany brown. Color to be selected by College's Representative.
   4) Designed for Use in Steel Doors
   5) Operates in steel door and frame at gap up to:
      a) 1" min., Steel Doors
      b) 2" Min, Wood Doors
   6) Under Door Threshold switches. At all glass door assemblies with base lock plate, mount DS under door threshold. Provide necessary blocking and shimming and/or secondary magnets at recessed doors to bring magnet within specified gap.

3. Manufacturer:
   a. Steel Doors, 1"
      1) Sentrol 1076W.
   b. Under threshold:
      1) Sentrol 1921 magnet and 1055 or 1075W Switch
      2) Or approved equal by Ademco.

C. Door Switch, RollUp Doors and Coiling Grills

1. Drawing Reference: DU
2. Function/Features:
   a. Protects openings where door or gate travels in vertical plane.
   b. Place door switches on slab at side of track or at top of frame at each end of rollup door or grill.
   c. Fasten magnet to traveling door.
   d. Switch connects to structure with armored cable connection.
3. Manufacturer:
   a. Sentrol 1982 Magnet and 2202A or 2205 switch with Manufacturer's Supplemental Mounting Brackets and Spacers as required. At panel/sectional doors Sentrol 2300 series.
   b. Ademco
   c. or equal.

D. Gate Switch

1. Drawing Reference: GS
2. Function/Features:
   a. Monitors status of gate protected openings.
   b. Fasten magnet to traveling/moving gate with tamperproof fasteners.

c. Switch connects to conduit and backbox infrastructure with armored cable connection.

3. Manufacturer:

a. Sentrol 1982 Magnet and 2202A or 2205 switch with Manufacturer's Supplemental Mounting Brackets and Spacers as required. At panel/sectional gates, provide Sentrol 2300 series.

b. Ademco

c. or equal.

E. Hatch Switch

1. Drawing Reference: HS

2. Monitors state of roof hatches

3. Fasten magnet to hatch door.

4. Switch connects to structure at hatch opening with armored cable connection to serving junction box

5. Manufacturer:

a. Sentrol 2500 series

b. Ademco.

c. or equal.

F. Local Door Alarm, Interior

1. Drawing Reference: LA

2. Functions/Features:

a. Provide door management alarms for local and remote monitoring and annunciation of the status of the doors (door prop/door held, door intrusion/door forced or secure)

b. The LA shall be capable of operating in a stand-alone configuration or with access control systems.

c. Local sounder (field selectable 96 or 103 dBA @ 3 feet) shall be used to indicate both door prop/door held and intrusion/door forced conditions after a user selectable quiet, or access, time (0 seconds - 90 minutes) has expired. Sounder shall be incorporated into the faceplate of the LA.

d. Form C (N/O or N/C) contacts shall be available for the following outputs:
1) Door Contact Status.
2) Door Prop Alarm.
3) Intrusion & Tamper Alarm.
4) Bypass/ Key Switch Status.
5) Dry Contact Remote Alarm Reset.

e. The alarm (intrusion) contact shall change state upon the recognition of an alarm or tamper condition to alert remote monitoring equipment.

f. The unit shall remain in alarm until reset by integral key switch, remotely through a dry contact or automatically through an onboard timer (settable from 0 seconds to 5 minutes or manual).

g. An integral key switch shall be available for alarm shunt or alarm reset and be incorporated into the faceplate of the LA.

h. A Bi-Color status L.E.D. shall be incorporated into the faceplate of the LA. A remote L.E.D. output shall be provided to control a Bi-Color L.E.D. that follows the actions of the faceplate mounted L.E.D.

i. Inputs shall include a N/C Dry Contact for the door, Voltage Sense (12-24 VAC/DC) to monitor electric lock voltages and a N/O or N/C passive Shunt Input.

j. The following timers shall be user settable:
   1) Auto-reset,
   2) Alarm delay
   3) Silent time
   4) Shunt Delay.

k. The LA shall be mounted in the wall adjacent to the monitored door at PSSH.

3. Manufacturers:

   a. Designed Security, Inc. Model ES4200-K4-T1 w/ Rim Cylinder Keylock K option and a tamper circuit.
      1) As exterior locations, provide with manufacturer's -007 component weatherization option.

G. Request to Exit

1. Drawing Reference: REX

2. Function:

   a. Closure disarms security when approaching door from inside. Omit where base building door hardware incorporates a release button.

   b. Passive infrared technology.

   c. Dual "C" shaped patterns adjustable to limit protection area to areas immediately in front of and to each side of means of approach to protected doors from interior.
      1) ± 14° vertically adjustable pattern.
      2) Dual C shaped patterns require activation from outside ring (lobby interior) prior to activation from inner ring (adjacent door) to prevent operation of door by sliding object under door from outside of building.

3. Select device and pattern based on mounting height and architectural geometry around door.

4. Finish to be selected by College's Representative.

5. Manufacturer:

   a. Detection Systems DS-150i

   b. or equal.

H. Tamper Alarm Switch

1. Select to suit application.
2. Manufacturer:
   a. Sentrol.
   b. Ademco.
   c. Or equal.

2.4 IP NETWORK COMPATIBLE VIDEO INTERCOM SYSTEM

A. Entry Video Intercom

1. Drawing Reference: VI, VM
2. Features/Operation
   a. Power Source: Power over Ethernet (802.3af).
   b. Network Interface: 10 BASE-T / 100 BASE-TX Ethernet (RJ-45).
   c. Network Protocols: IPv4, IPv6, TCP, UDP, SIP, HTTP, HTTPS, MJPEG, RTSP, RTP, RTCP, IGMP, MLD, SMTP, DHCP, NTP, DNS.
   d. Bandwidth Usage:
      1) G.711: 64Kbps x 2 per video call.
      2) 64Kbps per monitor.
      3) H.264: 24Kbps ~ 2,048Kbps.
   e. Communication: Hands-free (VOX), push-to-talk (simplex), or handset (full-duplex).
   f. Door Release: Programmable Form C dry contact, 24V AC/ DC, 500mA - use EL-12S (use RY-24L for larger contact rating, which requires 24V DC power supply) or use RY-IP44 with 4 multipurpose relays.
   g. Wire Type: CAT-5e or CAT-6.
   h. Distance:
      1) Door Station to Network Node: 330 feet (100 meters).
      2) Master Station to Network Node: 330 feet (100 meters).
   i. IP Addressable Video Master Station Model IX-MV:
      1) 3.5” LCD color monitor
      2) Handset for privacy or hands-free VOX / PTT communication
      3) Door release button
      4) 6 programmable speed dial buttons for calling stations or accessing paging zones
      5) Wall or desk mount
      6) Connects using CAT-5e/6 cable
      7) 802.3af PoE compliant
      8) IP Addressable Video Door Station Model IX-DV:
      9) SIP 2.0 compliant
      10) 1.23 megapixel fixed color video camera
      11) White LED for low light illumination
      12) ONVIF Profile S compliant
      13) Camera vertical adjustment +15º, 0º, or -8º (manual)

14) Slot for microSD card (not provided by Aiphone)
15) Weather and vandal resistant
16) 2 contact outputs
17) 6 trigger inputs
18) Anodized aluminum
19) 802.3af PoE compliant
20) RJ45 in/out with PoE pass through (802.3at Type 2 PoE+)

j. Manufacturer:
1) VM: Aiphone
a) Wall Mount: Model IX-MV7-W.
b) Desk Mount: IX-MV
2) VI: Aiphone Model IX-DV.

2.5 ACCESS CONTROL WIRING

A. As specified in Section 28 05 13 – Conductors and Cables for Electronic Safety and Security.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall install all system components, including College furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown and necessary to provide a fully functional system. The contractor shall furnish necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

B. Provide mounting hardware as necessary to securely fasten ACS hardware to the supporting structure or racks.

C. Device Wiring and Communication Circuit Surge Protection

1. All inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. All communications equipment shall be protected against surges induced on any communications circuit. All cables and conductors, except fiber optics, which serve as communications circuits from security console to field equipment, and between field equipment, shall have surge protection circuits installed at each end.

D. Installation

1. The contractor shall install the system in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type. Components within the system shall be configured with appropriate service points to pinpoint system trouble in less than 20 minutes.

2. Flexible cords or cord connections shall not be used to supply power to any components of the system, except where specifically noted. All other electrical work shall be as specified in Division 26 and as shown.

3. All circuit boards are to be mounted on "Stand-Offs". Circuit boards may not be affixed with double sided tape.

4. No components of the security system are to be mounted on the interior door of the DGP enclosure. Where additional space is required, Contractor to place a supplemental NEMA enclosure adjacent to the DGP sized as required to accommodate the additional components.

5. Perimeter Wireway: Refer to the requirements of Section 28 05 28 - Pathway for Electronic safety and Security regarding the requirement to wrap the backboard at electronic security system installation locations with steel wireway/gutter and terminal cabinets as necessary to fully enclose wiring and components associated with electronic security systems installation.

6. Enclosure Penetrations

7. Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in a manner that does not damage the cable. Locate penetrations to enclosures to ensure they will not interfere with components inside enclosure such as batteries, circuit boards, locking mechanisms etc.

8. Cold Galvanizing

9. Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc., shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

E. Card Readers

1. Contractor to coordinate detail construction work in vicinity of card readers with work of other trades to ensure that specified read range of card readers is not compromised by the presence of large metal objects in the immediate vicinity of reader

2. Securely fasten card reader to structure to prevent its movement during repeated usage.

3. Unless otherwise indicated, card readers to be mounted to the nearest side of the door housing the door handle.

4. Unless otherwise indicated, card readers should be mounted to flush mount backboxes. Mounting card readers on surface mounted boxes is unacceptable except where such installations are specifically called for in the plans.

5. Contractor to further ensure that power supplies used with the readers meet or exceed card reader manufacturer minimum requirements for current and voltage stability.

6. Exterior card reader installations must be equipped with the appropriate weather protection.

3.2 PROGRAMMING

A. Initial Systems Programming

1. Contractor to meet with College's Representative to confirm functional requirements for surveillance systems defined in Part 1 of this Section, including but not limited to the following:

a. Access Classification Tiers. Establish Tiers and Classes of Doors and the levels of protection to required at each including:
1) Monitoring to be provided at each Alarm point.
2) Always on (24 hour response).
3) On when the system is Master Armed.
4) Only on when the system is Perimeter Armed.
5) Displays / Does Not Display at the Access Control Panel when the point is activated.
6) Provides / Does Not Provide entry warning tone.
7) Sounds / Does Not Sound audible alarm indication.
8) Point is bypassable / not bypassable.
9) Alarm Verification with programmable verification time.
10) Summary Relay activation by Point.
11) Provides / Does Not Provide "watch point" capability.
12) Review with the College the means to be used to transition from one condition to another.
a) Example. During Pre-Game conditions, Audience entry doors are secured and alarmed. Operation from the interior or force entry from exterior to generator alarm. At the transition from Pre-Game to Game condition, Audience entry doors are released for free operation and alarming is suppressed until transition to Post Game.
13) Threat Level
a) Programming should incorporate altered conditions of operations at each opening for each Event Condition based on Threat Level established and selected by Command Center operators.

b. Calendar. System Operations as a function of day-of-the-week and hour-of-the-day and differential access permitted based on these changes, particularly for No Scheduled Event Condition.
1) Access limitations and device functions that are dependent on the time or access or the event.

c. Alarm System response to events
1) Normal access (validated).
2) System fault
3) Unauthorized access
4) Unauthorized access detected by multiple monitoring points.

d. Pass codes according to the authorities and functions defined by the College's Representative.

e. In addition to standard door operation arming and alarming as described in Part 1 of this Specification Section, initial system programming to include the following features and functions:
   1) Arming Zones – at least the following:
      a) Classrooms
      b) Training Offices
      c) OEM Offices
      d) EOC

f. Document the Initial Programming Requirements and Submit in accordance with Section 28 05 00 - Common Work Results For Electronic Safety and Security.

2. At minimum, include allowance of post-opening programming time in the following quantities.

   a. In addition to providing the programming necessary to meet the functional requirements defined in Part 1 of this Section, Contractor to provide systems customization programming time as defined below in the following quantities:
      1) 100 hours.

   b. Programming time is time spent by a trained systems programming developing the specific sequence of alarm events and response for this Project.

   c. Programming time does not include installation of or correcting deficient installation of system components, coordination with the contractors, training the programmer in the programming of the system software or meeting with the the College's Representative(s) to establish the functional requirements of the security system.

   d. Programming time not used in initial systems configuration shall be available to the College for supplemental post-opening programming. Contractor to provide such post opening programming in a minimum of 4 hour blocks.

   e. Contractor to provide College's Representative with daily timesheets of programming time spent in support of this Project on request"

   f. Implement System Programming as defined above.

3.3 WIRING PRACTICE

A. Comply with requirements of Sections 27 11 16 - Communications Cabinets, Racks, Frames and Enclosures and Section 28 05 13 – Conductors and Cables for Electronic Safety and Security

B. At electric strikes and electric locks and all other monitored lines requiring same, provide end-of-line resistors, diodes or MOV’s where device does not already include such components. Document where such devices have been added.

3.4 INTRUSION DETECTION FIELD DEVICE INSTALLATION

A. Motion Detectors

1. Orient device and place manufacturers device masking to eliminate potential sources of false motion or IR alarms including motion and/or vehicle headlights through windows, sunlight and sun reflections, HVAC diffusers, and heating/cooling appliances. Test and adjust as required over at least 2 weeks of operation following the latest of the following:

   a. occupancy by the College,

   b. commissioning of building systems,

   c. removal of construction barriers and/or

   d. installation of permanent window coverings.

B. Glass Break Detectors

1. Orient to maximize system sensitivity to glass breakage along indicated area for protection. Select variable spectral sensitivity of device to match construction of glass installed in area of protection. Adjust as necessary to eliminate false alarms.

C. Duress Alarms

1. General: Conform with UL 636.

2. Casework and Furniture Duress Alarms:

   a. Provide at points within the protected area as indicated.

   b. Alarms shall be capable of being secretly activated by the foot or hand of an average adult in both standing and seated positions.

   c. Alarms shall not be visible or audible from the sensor.

   d. Mock up proposed mounting location with for review by the College's Representative. Following acceptance by College's Representative, fasten securely in place with a mechanical, not adhesive, means.

   e. Protect and secure signal cable where it extends under surface of desktop using surface raceway mechanically fastened to underside of desk. Where the cable extends through furniture accessible to end users or the action of drawers or doors, protect with split loom tubing fastened mechanically to the surface of the furniture. Adhesive fastening in lieu of mechanical fastening will not be accepted.

   f. Route cable to grommeted cover plate at nearest accessible wall providing transition of cabling to concealed in-wall/raceway wire pathway.

D. Tamper Switches

1. Enclosures, cabinets, housings, boxes, raceways, and fittings with hinged doors or removable covers which contain circuits of the intrusion detection system and associated power supplies shall be provided with cover having corrosion-resistant tamper switches. Arrange tamper switches to initiate an alarm signal when the door or cover is moved as little as 6 mm 1/4 inch from the normally closed

position. Mechanically mount tamper switches to maximize defeat time when enclosure covers are opened or removed. Minimum amount of time required to depress or defeat the tamper switch after opening or removing the cover shall be one second. Enclosure and tamper switch shall prevent direct line of sight to internal components and prevent switch or circuit tampering. Conceal mounting hardware so switch cannot be observed from enclosure exterior. Covers of junction boxes provided to facilitate initial installation of the system need not be provided with tamper switches if covers contain no splices or connections. Tamper switches on doors which must be opened to make normal maintenance adjustments to the system and to service power supplies shall be the push/pull-set, automatic-reset type.

2. Tamper switches shall be:

   a. Inaccessible until switch is activated;

   b. Under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating;

   c. Spring-loaded and held in the closed position by the door, or cover protected;

   d. Wired to break the circuit when the door or cover is disturbed;

3.5 SYSTEM STARTUP

A. Satisfaction of the requirements below does not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment. The Contractor shall not apply power to the system until after:

1. System equipment items have been set up in accordance with manufacturer's instructions.

2. A visual inspection of the system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected.

4. System grounding and transient protection systems have been verified as properly installed.

5. Power supplies to be connected to the system have been verified as the correct voltage, phasing, and frequency.

3.6 SYSTEMS PERFORMANCE DEMONSTRATION AND ADJUSTING PROCEDURES

A. Demonstrate functionality of each installed device. Refer to the requirements of Section 28 05 00 - Common Work Results for Electronic Safety and Security.

3.7 LABELING

A. Conform with the requirements of Section 27 05 53 – Identification for Communications Systems.

3.8 WARRANTY

A. Warranty

1. The ACS shall be warranted by the contractor for one (1) year from the date of Substantial Completion.

B. Maintenance and Service

1. The contractor shall provide all services required and equipment necessary to maintain the entire ACS in an operational state as specified for a period of one (1) year after formal written acceptance of the system, and shall provide all necessary material required for performing scheduled adjustments or other nonscheduled work.

C. Description of Work

1. The adjustment and repair of ACS includes computer equipment, contractor provided programming, software updates, signal transmission equipment, access control equipment, facility interfaces, and support equipment. Provide the manufacturers required adjustments, re-programming of deficient contractor programmed functions and other work as necessary.

D. Personnel

1. Service personnel shall be qualified to accomplish all work promptly and satisfactorily. Provide proof that Service personnel have successfully completed the enterprise level of both hardware and software training offered by the system manufacturer. The College's Representative shall be advised in writing of the name of the designated service representative and of any change in personnel.

E. Inspections

1. The contractor shall perform two inspections at six (6) month intervals or more often if required by the manufacturers. This work shall be performed during regular working hours, Monday through Friday, excluding Federal holidays. These inspections shall include:

2. Visual checks and operational tests of the central processor, local processors, monitors, keyboards, system printers, peripheral equipment, ACS equipment, power supplies, and electrical and mechanical controls.

3. Clean system equipment, including interior and exterior surfaces.

4. Perform diagnostics on all equipment.

5. Check and calibrate each ACS device.

6. Run system software and correct diagnosed problems.

7. Resolve previous outstanding problems.

F. Warranty Service

1. The College’s Representative shall initiate service calls when the ACS is not functioning properly. Qualified personnel shall be available to provide service to the complete ACS.

2. The College's Representative shall be furnished with the telephone number where the contractor's service supervisor can be reached at all times.
3. Service personnel shall be at the site within four (4) hours after receiving a request for service.
4. The ACS shall be restored to proper operating condition after one (1) calendar day.
5. Materials installed during warranty service to match or exceed specification of products originally installed for the specified function.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. SCOPE

1. Section includes (but is not necessarily limited to) provision of field devices for intrusion detection system, including but not limited to:
   a. Intrusion Detection. Installs field devices.
      1) Includes
         a) Door position switches
         b) Motion Detector

1.2 RELATED WORK IN OTHER SECTIONS

B. Section 27 05 33 - Conduits and Backboxes for Communications Systems

1. Rough-in for devices installed by the work of this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Include full range of interior point protection sensors, volumetric (space) protection sensors, exterior fence sensors, and duress alarms. Select device to suit project conditions per manufacturers recommendations.

2.2 ALARM SENSORS & FIELD DEVICES

A. Door Position Switch

1. Drawing Reference: DS

2. Construction and Features
   a. UL Listed
   b. Double Pole, Double Throw (DPDT) electrical configuration.
   c. Hermetically sealed magnetic reed switch. Dual biased high security switch assembly deters tampering. Reed shall be potted in the contact housing with a polyurethane based compound.
   d. Magnet shall be made of Alnico V.
   e. Steel Door Switches
      1) Contact and magnet housing shall snap-lock into a 3/4" or 1" dia. hole. Snap-lock insulation bushing for tight fit and maximum gap in steel.
      2) Housings shall be molded of flame retardant ABS plastic. Both contact and magnet plastic housings are constructed of one piece of thick-walled ABS plastic for maximum strength.
      3) Color of housings shall be off-white, grey or mahogany brown. Color to be selected by Architect.
      4) Designed for Use in Steel Doors

5) Operates in steel door and frame at gap up to:
   a) 3/8" min. - 3/4" Doors
   b) ½" min. - 1" Doors
6) Under Door Threshold switches. At all glass door assemblies with base lock plate, mount DS under door threshold. Provide necessary blocking and shimming and/or secondary magnets at recessed doors to bring magnet within specified gap.

f. Leads:
   1) Black: Common
   2) White: Closed Loop
   3) Red: Open Loop

3. Manufacturer:
   a. Steel Doors, 3/4"
      1) GE/Sentrol 1076D switch with 1921C magnet.
      2) Or equal by Ademco.
   b. Steel Doors, 1"
      1) Sentrol 1076D switch with 1921C magnet.
      2) Or equal by Ademco.
   c. Under threshold:
      1) Sentrol 1921 magnet and 1055 or 1075WSwitch
      2) Or equal by Ademco.

B. Motion Detector

1. Drawing Reference(s): MD, MDC

2. Functions/Features/Construction:
   a. Dual detection device detects change in background heat levels associated with passage of an intruder through passive infrared technology (PIR) and microwave reflection. Both detectors need to activate to signal an alarm conditions.
   b. Immune to rodent motion.
   c. Pulse Count: Installer-selectable, 1- or 2-event
   d. Detectable Walk Rate: 2-4 steps within field-of-view
   e. Indicators: Red LED with enable/disable feature
   f. Alarm Relay: Form C
   g. Operating Temp: At least 32º to 120ºF
   h. Operating Humidity: At least up to 95% RH (max.), non-condensing
   i. Dimensions: Not larger than 5"x5"
   j. K-Band Microwave
   k. Where exterior device installation shown, devices to suitable for outdoor use under Project conditions
   l. Corridor and Aisles Conditions, MDC
      1) Select device and configure device lens(es) and masks to monitor area nominally 20 degrees wide from point that device is installed to architectural barrier opposite or cross-aisle opposite of the device, unless otherwise indicated.
   m. Ceiling Mount Applications

1) Ceiling Mount Design. 360° field-of-view, mounting height from 8' to 16', install as recessed mount, unless otherwise noted.

n. Coverage - At least 25' diameter
o. Listings/Approvals
1) UL Listed
2) FCC Certified

3. Manufacturers - coordinate selected device with ceiling height and manufacturers instructions:
a. MD, Ceiling Interior
1) Ademco DT 7360
2) Rokonet Lunar DT
3) Bosch
4) Sentrol
5) or equal
b. MDC, select and submit for each condition.
1) Rokonet iWISE DT with ACT
2) Ademco
3) Bosch
4) Sentrol
5) or equal
c. MD, Exterior Conditions
1) Rokonet iWiseDT QUAD with ACT and optional ceiling swivel
2) Ademco
3) Bosch
4) or equal

C. Glassbreak Detectors, Recessed

1. Manufacturer:
a. Rokonet Vitron Plus.
b. GE Sentrol
c. Bosch
d. Ademco
e. Or approved equal

D. Glassbreak Detectors, Surface

1. Manufacturer:
a. Rokonet Vitron Plus.
b. GE Sentrol
c. Bosch
d. Ademco
e. Or approved equal

2. Intrusion Alarm Sounder
a. Drawing Reference: IAS
b. Function:
1) Low profile, electronic piezo, compact multi-tone sounder

2) Selectable 32 different tones
3) White ABS housing
4) Operates on 9–28VDC
5) Produces 82-100 dBa @ 10' (92-110 dBa @ 1m) with 20 dBa of adjustment
6) IP54 enclosure (IP65 with optional deep base)
7) Panel or wall mount

c. Manufacturer:
1) Federal Signal LP4-09-028
2) Or equal

2.3 Power Supplies

A. Power Supply, Backboard Mounted

1. Drawing Reference(s): POWER SUPPLY

2. Backboard mounted equipment

3. Function:
a. Power supply with backup battery
b. Class 1 (115VAC Input)
c. Individually fused, Power Limited, Class 2 outputs - sized to meet worst case load and runtime while maintaining system operations.
d. Unless otherwise indicated support operations of field devices and doors for at least 10 minutes following loss of power.
e. Provide timer modules as required to supplement ACAS operations.
f. Battery is lead acid type of common commercial manufacture.
g. UL Listings: UL 294, UL603, UL 1069, UL1481 for application
h. Power supply and battery fully enclosed in steel NEMA enclosure with cam lock cover and conduit knockouts.
i. Thermal and short circuit protection with auto reset.

4. Manufacturers:
a. Altronix
b. Dynalock
c. Locknetics
d. RCI
e. Securitron
f. Security Door Controls
g. or equal

2.4 INTRUSION DETECTION SYSTEM

A. Intrusion Detection Panel/ Digital Alarm Communicator and Access Control System (DACS)

1. Drawing Reference: Intrusion Detection Panel, Burglar Panel

2. Features/Functions/Construction

a. 246 hardwired, addressable or wireless points with flexible configuration options.
b. Conettix IP-based communication options provide high-speed, secure alarm transport and control through connection of wired and/or cellular network interfaces.
c. Up to 32 programmable areas, each supporting perimeter and interior points with touch screen, ATM style, or LED keypads.
d. Compatibility with touch-screen color LCD, vacuum fluorescent, ATM style LCD or LED style Alarm Command Centers
e. Program all system functions local or remote using Remote Programming Software (RPS) or by using basic programming through the keypad.
f. Integrated real time clock, calendar, test timer and programmable scheduling capability for relay control and automatic execution of system functions based on a time / event.
g. Provide 1.4 amps of auxiliary power and 2 amps of alarm power, both rated at 12 VDC.
h. Supervision of up to 16 keypads (up to 32 unsupervised keypads can be used).
i. The system supports up to 1000 users, each can have a passcode, an access token and a wireless keyfob. User passcodes contain three to six digits. Passcodes can be assigned to one of 14 customized authority levels in each area, and can be restricted to operate only during certain times.

3. Manufacturer:
   a. Bosch Security Systems, Inc. D9412GV4 Control Panel with the following:
      1) D1255 Alpha Keypad. Provide quantity of Keypads shown on plans.
      2) D8103 Universal Enclosure
      3) Conettix B426 Ethernet Communication Module
      4) B208 Octo-input Module
      5) B308 Octo-output Module
      6) B520 Auxiliary Power Supply Module
      7) D8129 Octo-relay Module
      8) D9127 Series POPIT Modules
      9) D8125 POPEX Point Expander
      10) D8128D OctoPOPIT Eight-point Expander

PART 3 - EXECUTION

3.1 Manufacturer Instructions

A. Conform to manufacturer instructions and the requirements of this specification section, whichever is more restrictive.

B. Conform to UL 681, UL 1037, and UL 1076, and the appropriate installation manual for each equipment type. Components within the system shall be configured with appropriate "service points" to pinpoint system trouble in less than 20 minutes.

C. Wiring and device mounting, except for type DU, shall be fully concealed or flush in mounting surface. No devices shall be surface mounted unless specifically called for.

D. For devices requiring access and operation by building occupants, install in accordance with the U.S. Department of Justice, Americans with Disabilities Act (ADA) and the State of California Access Compliance Manual.

3.2 LABELING

A. Conform with the requirements of Section 27 05 53 – Identification for Communications Systems.

3.3 SYSTEMS PERFORMANCE TESTING AND ADJUSTING PROCEDURES

A. Demonstrate functionality of each installed device is consistent with the read range, sensitivity and immunity to false alarms as specified by the device manufacturer. In the absence of an intrusion detection panel installed by Others, demonstrate using a VOM applied at the TB15 terminal block in the presence of the Agency's Representative.

B. Test shall ensure that the requisite degree of intrusion detection is provided.

1. Initially, test each sensor and subsystem component individually.

2. When the function of each component within a particular subsystem such as each sensor within a particular zone is verified, certify that subsystem of the entire ACAS as satisfactorily meeting required specifications. Test each subsystem similarly until each detection zone has been certified.

3. When subsystem certification is complete, test entire integrated system to ensure that subsystem elements are compatible and function as a complete system. Integrated system test shall be accomplished in linear fashion, end-to-end, and shall verify that each simulated intrusion performed within each detection zone produces an appropriate alarm or signal.

4. Integrated system test shall also verify that alarm is correctly annunciated at the terminal block associated with the field devices,

5. Log the results obtained for each device, sign log and submit for review prior to request for Demonstration of Functionality.

6. Provide for approval, not later than 30 days prior to formal inspection and test, a detailed operational test plan of how each component, subsystem, and entire ACAS will be tested.

7. When tests are complete and corrections made, submit a signed and dated certificate with a request for formal inspection and tests.

3.4 DEMONSTRATION OF FUNCTIONALITY

A. The Agency's Representative will witness formal tests after receipt of written certification that preliminary tests have been completed and that system is ready for final inspection. Manufacturer's technical representatives shall be present for the final inspection and test. Repeat preliminary tests and functional and operational tests,

conducted as requested by the Agency's Representative. Correct defects and conduct additional tests to demonstrate that system conforms to contract specifications.

B. Motion Detection

1. Demonstrate that each device detects an intruder moving through the specified coverage pattern.

C. Window, Hatch and Door Position Switches

1. Demonstrate functionality of each device when door, hatch or window door, hatch or window operated and opened not more than 3/8".

3.5 WARRANTY, MAINTENANCE AND SERVICE

A. Warranty

1. The IDS sensors shall be warranted by the contractor for one (1) year from the date of final system acceptance.

2. Maintenance and Service
   a. The contractor shall provide all services required and equipment necessary to maintain the IDS remote sensors in an operational state as specified for a period of one (1) year after formal written acceptance of the system, and shall provide all necessary material required for performing scheduled adjustments or other nonscheduled work.

3. Description of Work
   a. The adjustment and repair of IDS remote sensors includes signal transmission equipment, facility interfaces, and support equipment. Responsibility shall be limited to contractor installed equipment. Provide the manufacturers required adjustments and other work as necessary.

B. Personnel

1. Service personnel shall be qualified to accomplish all work promptly and satisfactorily. Provide proof that Service personnel have successfully completed the appropriate level of hardware training offered by the system manufacturer. The Agency shall be advised in writing of the name of the designated service representative and of any change in personnel.

C. Inspections

1. The contractor shall perform two inspections at six (6) month intervals or more often if required by the manufacturers. This work shall be performed during regular working hours, Monday through Friday, excluding Federal holidays. These inspections shall include:

2. Visual checks and operational tests of the remote sensorts, power supplies, and electrical and mechanical controls.

3. Clean system equipment, including interior and exterior surfaces.

4. Perform diagnostics on all equipment.

5. Check and calibrate each IDS device.

6. Resolve previous outstanding problems.

D. Emergency Service

1. The Agency shall initiate service calls when the IDS sensors are not functioning properly. Qualified personnel shall be available to provide service to the complete IDS sensors. The Agency shall be furnished with the telephone number where the contractor's service supervisor can be reached at all times. Service personnel shall be at the site within four (4) hours after receiving a request for service. The IDS sensors shall be restored to proper operating condition after one (1) calendar day.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED WORK IN OTHER SECTIONS:

A. Section 27 11 19 - Communications Termination Blocks and Patch Panels

1. Provides the patch panels, if not existing to support the cameras installed under the work of this project.

B. Section 27 15 00 - Communications Horizontal Cabling

1. Horizontal structured cabling to support the cameras installed under the work of this project.

C. Section 28 05 00 - Common Work Results for Electronic Safety and Security

1. Submittals required of the work of this section.

2. Miscellaneous parts and execution standards for the work of this Section.

D. Section 28 05 28

1. Provides raceway and backboxes for the work of this Section.

1.3 RELATED WORK BY OTHERS

A. The College supplies the POE enabled Ethernet Switches and related building Ethernet networking hardware used to transmit the packets generated by the cameras installed under the work of this Project.

1.4 SCOPE

A. Work of Division 28 includes provision of a Unified Security Platform (USP), including video surveillance systems as described in this Section. Work of Section 28 23 00 includes provision of the video surveillance portion of the USP, including but not limited to:

1. Video Surveillance System.

a. Single sensor type indoor, self-illuminated TCP/IP dome cameras.

b. 180 and 360 degree view high definition Multiview indoor and outdoor, self-illuminated TCP/IP cameras.

2. Video Management System (VMS) with:

a. Camera licensing for the quantity of cameras shown on the plans plus 10% spare licensing capacity.

3. Directory Server to be installed at the College Office.

4. Provide twenty (20) web client licenses for College's staff to use.

1.5 SUBMITTALS

A. Refer to the requirements of Section 28 05 00 – Common Work Results for Electronic Safety and Security.

1.6 SYSTEM PERFORMANCE REQUIREMENTS

A. Video Surveillance Systems:

1. Technical Performance:

a. TCP/IP: System demonstrates full conformance with alarming, video analytics functionality, including motion detection using ONVIF Software (Open Network Video Interface Forum) Protocol.

b. IP Cameras: Meet Manufacturers performance specification.

2. Functional Performance:

a. Monitor and Display
1) Remote monitoring and reviewing of recorded images by persons using:
a) College's Local and Wide Area Network.
b) Local Area Network using College furnished network switching, and cabling provided under the work of this Project.
2) Provide images suitable for making identification of persons under lighting conditions resulting from the work of this Project and the prevailing environmental conditions at the Project site.

3. Uninterrupted Power System: For systems deriving camera power from power supplies installed under the work of this Project, sustain system operation for 2 hours following loss of power.

1.7 COORDINATE

A. Coordinate intended camera locations with the work of the Other Trades and the work of Section 28 05 28 – Pathways for Electronic Safety and Security to ensure field conditions do not result in obscuring the intended camera view(s).

B. Refer to Division 27 specifications to ensure that station cabling required for the work of this section.

1.8 DEFINITIONS

A. Refer additionally to Section 28 05 00 - Common Work Results for Electronic Safety and Security.

B. Abbreviations used in this Section

1. ACS – Access Control System

2. AES: Advanced Encryption Standard
3. AGC: Automatic gain control
4. ALPR – Automated License Plate Recognition
5. API: Application Programming Interface
6. Aspect ratio: A ratio of width to height in images
7. Bit Rate: The number of bits/time unit sent over a network
8. Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
9. CSA – Client Software Application
10. DGM – Dynamic Graphical Maps
11. DHCP: Dynamic Host Configuration Protocol
12. DNS: Domain Name System
13. DVS – Digital Video Server
14. EIS: Electronic Image Stabilization
15. FPS: Frames per Second
16. FTP: File Transfer Protocol
17. H.264 (Video Compression Format)
18. IEEE 802.1x: Authentication framework for network devices
19. IP: Internet Protocol
20. IR light: Infrared light
21. ISO: International Standards Organization
22. JPEG: Joint Photographic Experts Group (image format)
23. LAN: Local Area Network
24. LED: Light Emitting Diode
25. LPR: License Plate Recognition
26. Lux: A standard unit of illumination measurement
27. MBR: Maximum Bit Rate
28. MPEG: Moving Picture Experts Group
29. Multicast: Communication between a single sender and multiple receivers on a network
30. NTP: Network Time Protocol

31. NTSC: National Television System Committee – a color encoding system based on 60Hz
32. ONVIF: Global standard for the interface of IP-based physical security products
33. PACS: Physical Access Control System
34. PAL: Phase Alternating Line – a color encoding system based on 50Hz
35. PTZ: Pan/Tilt/Zoom
36. PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
37. PPF: Pixels per foot
38. Progressive scan: An image scanning technology which scans the entire picture
39. QoS: Quality of Service
40. RAID: Redundant Array of Independent Disks
41. SDK – Software Development Kit
42. SIP: Session Initiation Protocol
43. SMA – Software Maintenance Agreement
44. SMPTE: Society of Motion Picture and Television Engineers
45. SMTP: Simple Mail Transfer Protocol
46. SNMP: Simple Network Management Protocol
47. SSL: Secure Sockets Layer
48. SSM – Server Software Module
49. SaaS: Software as a Service
50. TCP: Transmission Control Protocol
51. TLS: Transport Layer Security
52. UI: User Interface
53. UPS: Uninterruptible Power Supply
54. UPnP: Universal Plug and Play
55. USP: Unified Security Platform
56. USW: Unified Web Client
57. Unicast: Communication between a single sender and single receiver on a network
58. VBR: Variable Bit Rate
59. VMS: Video Management System

60. WDR: Wide dynamic range

1.9 LABELING AND DOCUMENTATION

A. Label the finished installation. Label each cable at each end uniquely using a Brady or similar cable labeling system.

B. Document the camera locations on a floor plan using CAD. Indicate the head end rack location and the major wiring runs. Provide a single-line diagram of the installed system. Submit PDF copies of the as built drawing documentation. In addition submit electronic copies of the CAD files for the College's use. Submit electronic files on a media type determined by the College.

C. Prepare and provide a hard copy and an electronic copy of an O&M manual for for the completed installation. Hard copy to be provided in a three ring binder. The electronic copy to be submitted on a PDF on a media type determined by the College's Representative.

1.10 TRAINING

A. Train the College's Representatives in operation of the installed video management system. Provide a least two separate training tracks focused on the training needs of specific stakeholder groups within the College’s operation and technical staff and College’s Technical/Information Technology Support Staff.

1. For the Colleges Technical/Information Technology Support Staff and third party integrators staff provide eight hours classroom and hands-on training in VMS system functionality, IP communications protocols used and device handshaking. Review directory tree integration mechanisms and requirements for tree maintenance. Review methods for bare metal recovery of operations. Review VMS manufacturer’s approved methods for software upgrades and hardware replacement, including failed disks in the storage array.

2. For each Training session, Document the training provided using a camera and video recorder and provide a copy of the recorded training to the College for future reference and use in training new staff.

1.11 QUALITY ASSURANCE

A. Test Equipment - provide for the purposes of quality assurance as described in Section 28 05 00 - Common Work Results for Electronic Safety and Security.

1. Network Packet Analyzer: (Fluke, Wireshark)

2. Waveform/Vector Monitor.

3. Portable High Resolution Color Picture Monitor (Marshall Electronics, ToteVision or equal).

PART 2 - PRODUCTS

2.1 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the College.

2.2 ACCEPTABLE MATERIALS

A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.

2.3 VIDEO SURVEILLANCE EQUIPMENT

A. General:

1. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's Video Surveillance System.

2. All systems and components shall have been thoroughly tested and proven in production use for at least180 days prior to the installation of this system.

3. All Video Surveillance System active systems components shall be provided with the availability of a toll free, 24-hour technical assistance program from the manufacturer, which provides immediate technical assistance to the end user at no charge. Where supplied systems are only supported through dealer liaison with manufacturer, and the College's Representative needs to speak with the VMS manufacturer during Contractor troubleshooting of integration, Contractor to initiate call.

2.4 VIDEO MANAGEMENT SYSTEM

A. Video Management Software

1. Description: Video surveillance management software (referred to as "system" or "VMS") supporting an unrestricted number of users, devices, servers and sites, with options for high availability, intelligent video walls, central surveillance operations and mobile devices.

2. System Architecture: The VMS shall consist of:

a. Servers: One or more VMS servers.

1) Physical or virtualized Windows servers.

2) Virtualized Windows servers, using:

a) Microsoft Hyper-V.

b) VMWare.

3) UPS provided to physical servers, network infrastructure and devices such as cameras.

b. Server Software Components: One or more Milestone XProtect software components, or software components made by others as noted, per VMS server.

1) Management Server: Central service component of the VMS responsible for handling system configuration, distributing the configuration to other system components, such as Recording Server services, and for facilitating user authentication.

2) Management Server Failover: A second server shall take over the Management Server function if the first server fails.

a) Failover Management Server: Installation of the Management Server service in a Microsoft Windows Failover Cluster, or similar compatible third-party software.

b) XProtect Management Server Failover: Installation of add-on in the VMS: A second server shall take over the Management Server, Log Server, Event Server, and SQL Server functions.

3) Recording Server: Service responsible for communications, recording and event handling for all devices (cameras, video and audio encoders, I/O modules, metadata sources, etc.), including:

a) Retrieving video, audio, metadata and I/O event streams from devices.

b) Recording video, audio and metadata.

c) Providing access to live and recorded video, audio and metadata.

d) Transmit live audio from operator’s microphone to one or more camera speakers or supported IP speakers.

e) Providing access to device status.

f) Triggering system and video events on device failures, events, etc.

g) Writes video streams, audio streams and their metadata to a high-performance media database.

h) Performing motion detection and generate smart search metadata.

i) Communicating with other Milestone products when using the Milestone Interconnect technology.

4) *Failover Recording Server:* Implementation of Recording Server service designated to take over recording and other tasks should an active Recording Server fail.

a) Failover Recording Server shall operate in two modes: cold-standby for monitoring multiple Recording Server services and hot-standby for monitoring a single Recording Server.

b) Both cold- and hot-standby mechanisms shall offer fully automatic and user transparent failover in the event of hardware or system failure, with automatic synchronization of video, audio and metadata at system recovery.

5) *Event Server:* Service that handles various tasks related to events, alarms, maps and third-party integrations via the Milestone Integration Platform Software Development Kit (MIP SDK).

6) *Failover Event Server:* Implementation of Event Server service by installing Event Server in a Microsoft Windows Failover Cluster, to ensure that another server takes over should the first server fail.

7) *Log Server*: Service that writes all system, audit and rule-triggered log messages to database.

8) *Service Channel*: Service responsible for communicating the following:

   a) Service and configuration messages to XProtect Smart Client.

   b) Updates to a Smart Wall monitor layout.

   c) Communicating that a specific Failover Recording Server is active.

9) *XProtect Mobile Server:* Service responsible for hosting the XProtect Web Client and for providing access to the VMS for XProtect Web Client and XProtect Mobile client users.

10) *Milestone Open Network Bridge:* Optional server, including Milestone Open Network Bridge service, Milestone RTSP Bridge service, and the Milestone Open Network Bridge Manager, plus 64-bit plug-in for Management Client. This is to enable private-to-public video integration.

11) *DLNA Server*: Service to enable display of live video on any DLNA compliant TV or displays without the need for additional equipment.

12) *Microsoft SQL Server*: Microsoft database server service for the Management Server, Event Server and Log Server services.

13) *API Gateway:* Service that provides a front-end and common entry point for RESTful API services on other VMS server components. *Microsoft Active Directory (required for MFA):* Active Directory is not required for single-site systems but is recommended for cyber security purposes.

c. *PC or Laptop Workstations:* One or more PCs or laptops for Milestone XProtect client software applications intended to run on Windows-based PCs and laptops.

   1) *Management Client:* The administration interface for all parts of the VMS, designed to be run remotely from, for example, an administrator's computer.

   2) *XProtect Smart Client:* Designed for day-to-day use by dedicated operators, to be run remotely on the operator's computer. XProtect Smart Client provides dedicated task-oriented tabs for Live Video, Video Playback, Search, plus dockable tabs for System Monitor and Alarm Monitor. XProtect Smart Client supports definable keyboard and joystick button shortcuts for frequently used actions, including window or camera selection.

   3) *XProtect Web Client:* Browser-based application for the occasional or remote user that needs easy access to live video monitoring and audio listening with PTZ control including use of presets, and video and audio

playback and export, with defined exports available for later usage or download.

d. *Tablets or Smartphones:* One or more tablets or smartphones using XProtect Web Client (see above) or XProtect Mobile client.

1) *XProtect Mobile Client:* Native mobile app for smartphone or tablet users, for easy access to live and playback of cameras, and to activate system events and outputs. Additionally, for use as a remote recording device by using the mobile device's built-in camera, whereby video from the device's camera is streamed back to the VMS and recorded like a standard camera.

e. *Smart Walls:* Optionally one or more Smart Walls.

1) See Section 28 51 19.13 VIDEO WALL.

f. *Wide-Area Surveillance System:* Optionally one or more individual Milestone VMS products connected to gain central surveillance operation across geographically dispersed sites.

1) See paragraph 2.3 C Multi-System Architectures below.

g. Networks:

1) *Multiple Network Segments*: The VMS must support network segmentation into separate device, server and internet-connected networks.

2) *Device Network:* Local network whose capacity and configuration are suitable for the level of video, audio and metadata data transmission established by the system design and its intended usage.

3) *Server Network:* Local network whose capacity and configuration are suitable for the level of video data transmission, systems integration, and user operations established by the system design and its intended usage.

4) *Internet-Connected Network*: Internet-connected network providing connection to remote VMS sites and private-to-public connection via Milestone Open Network Bridge. This network is also used for remote user access via the XProtect Mobile Server.

5) Network Traversal:

a) Enable software clients to access Recording Server services from outside a NAT firewall, by the use of public addresses and port forwarding.

b) Provide Remote Connect Services that enable secure remote connections to devices across different types of private and public networks.

3. *Multi-System Architectures:* Provide three architecture options for multi-site deployments:

a. *Distributed Recording Server Services:* Intended for sites with stable network connections between the central site and any number of remote sites.

1) Management Server at central site is providing user authentication and authorization for all distributed Recording Server services.
2) Each site has at least one Recording Server.

b. *Milestone Federated Architecture:* Intended for sites with stable network connections between all sites, establishes central management of, and central surveillance operations for, geographically dispersed sites via one or more levels of parent/child system connections. The federated architecture shall:

1) Management Server at parent site is providing user authentication for the full federated system and each child site Management Server is providing authorization.
2) Each site is equipped with one Management Server and at least one Recording Server.
3) Parent systems must be XProtect Corporate systems.
4) Child systems may be any number of XProtect Corporate, XProtect Expert, Milestone Husky M series, Milestone Husky X series and Milestone Husky IVO series systems.
5) Child XProtect Corporate and XProtect Expert systems function as autonomous sites even upon loss of network connectivity.
6) Make site details, including name, address, administrators and additional information, defined in the federated system available in the site navigation.

c. *Interconnected Architecture:* Suitable for providing central surveillance operations capabilities for a centrally XProtect Corporate-managed distributed system where some or all network connections between the local systems are unstable or intermittent. Capabilities shall include:

1) Management Server at central site is providing user authentication and authorization for all interconnected cameras.
2) Remote site is providing authentication and authorization to its cameras on central system access.
3) Central site is equipped with one Management Server and at least one Recording Server.
4) Remote site is one of the following products and their later editions:
   a) XProtect Corporate 2013
   b) XProtect Expert 2013
   c) XProtect Enterprise 8.0
   d) XProtect Professional 8.0
   e) XProtect Professional+ 2017 R2
   f) XProtect Express 1.0
   g) XProtect Express+ 2017 R2

h) Milestone Husky M20 2016 R2

i) Milestone Husky M30 2013

j) Milestone Husky M50 2013

k) Milestone Husky M500 Advanced 2016

l) Milestone Husky M550 Advanced 2016

m) Milestone Husky X2 2018 R2

n) Milestone Husky X8 2018 R2

o) Milestone Husky IVO 150D

p) Milestone Husky IVO 350T

q) Milestone Husky IVO 350R

r) Milestone Husky IVO 700R

s) Milestone Husky IVO 1000R

t) Milestone Husky IVO 1800R

5) *Site Independence:* Remote sites using the interconnected systems functionality shall operate as a full and separate VMS and NVR systems.

6) *Different Network Domains:* All or some systems may run on different network domains.

7) Number of Remote Sites: Any number of remote sites, which may run any size and any number of separate supported VMS and NVR systems.

8) *Upload Management:* Provide for the transfer of recordings from remote sites to the central site. It shall be possible at the central site to automatically or manually request recordings from the remote site, which requests shall be queued for execution once the remote site is connected to the central site's network. Users may define time intervals and bandwidth caps for upload of video from a remote site.

9) *Mobile and On-Premise VMS Support:* Remote sites can be on-premise systems or mobile systems, for example busses, trains and ferries and should be resilient to intermittent connectivity to central site.

10) *Status Detection:* VMS proactive detection of errors and cost-efficient management of connected sites by propagation of system status events and embedded remote management of connected system.

11) *Remote Management:* VMS detection of system problems and remote management of interconnected sites.

12) *Device Driver:* Connect the high-end VMS with most other VMS and NVR versions made by the software manufacturer through a device driver-based interconnected systems functionality.

13) *Central Video View and Playback:* Live video and playback of video for cameras from the remote site shall be the same as for cameras connected directly to the central site.

14) *Remote Camera Licenses:* VMS shall require a dedicated camera license for each interconnected camera that is enabled on the central site.

B. System Design Criteria

1. *Scalability:* Provide component-based system architecture to support scaling of VMS from small systems (up to 100 devices) to very large systems (several thousand devices) for single-site or multi-site deployment, whereby:
   a. *For Small Systems:* All software components can be installed on the same server if the server is able to handle the combined load.
   b. *For Large Systems:* Software components can be installed on separate dedicated servers to scale and distribute the load.
2. *Availability and High Performance:* Provide the following capabilities to ensure high VMS availability and performance.
   a. *Failover Recording Server:* Provide hot and cold Failover Recording Server capabilities.
   b. *Management Server, Event Server, Log Server, API Gateway*: Support Windows Server Failover Clustering, or similar.
   c. Storage solution shall be configured with RAID10 for Live database and RAID5 or RAID6 for archive database.
3. *Operating Systems:* Provide server and client software applications that are native 64-bit Microsoft Windows applications.
4. *Network Addressing:* Support both IPv4 and IPv6 addressing.
5. *Video Standards:* Provide simultaneous digital multi-channel live streaming and recording of video from IP cameras and IP video encoders without any software limitations on the number of cameras per Recording Server, with support for the following codecs and options:
   a. Codecs:
      1) H.264 and H.265
      2) MPEG-4 and MPEG-4 ASP
      3) MJPEG
      4) MxPEG
   b. Options:
      1) Toggling between recording key frames only or full video stream for MPEG-4, H.264 and H.265 video.
      2) Adjustable GOP length for MPEG-4, H.264 and H.265 video.
      3) Toggle between recording full framerate from the camera and any lower FPS for MJPEG video.
6. *Video De-Interlacing:* Provide live video views with an adaptive de-interlacing option, to improve the quality of interlaced video, based on the actual video

content received, for example, to smooth area of an image where object lines would otherwise appear as jagged lines.

7. *Multi-Live Video Streaming:* Provide multiple streams for live viewing using any combination of supported standards, video resolutions and frame rates.
8. *Adaptive Streaming:* Depending on the requested resolution, provide automatic selection between the video streams configured for multi-live video streaming to these clients:
    a. XProtect Smart Client: Live video streams from the Recording Server to the XProtect Smart Client or XProtect Smart Wall.
    b. XProtect Web Client: Live video streams from the XProtect Mobile Server to the XProtect Web Client.
    c. XProtect Mobile Client: Live video streams from the XProtect Mobile Server to the XProtect Mobile Client.
9. *Direct Streaming:* Provide live video streams in these codecs directly from the Mobile Server to clients without transcoding:
    a. XProtect Web Client: Provide MJPEG and H.264 live video streams.
    b. XProtect Mobile Client: Provide H.264 and H.265 live video streams.
10. *Audio Standards*: Provide simultaneous digital two-way audio streaming and recording of audio from IP speaker and IP microphone devices without any software limitations on the number of devices per Recording Server, with support for the following codecs and options:
    a. Codecs:
        1) AAC
        2) G711
        3) G726
    b. Options:
        1) Playback of audio files on rule.
11. *DLNA Support:* Provide the ability to easily display live video from the installed cameras directly onto any modern consumer-grade TV supporting DLNA functionality.
12. *Hardware Acceleration XProtect Smart Client:* Provide the following hardware acceleration capabilities to offload Smart Client video processing from the computer CPU to dedicated hardware video processing capabilities:
    a. *NVIDIA GPU:* Automatically detect and use all available NVIDIA GPUs, for hardware accelerated decoding, color correction, and scaling.
    b. *Intel Quick Sync:* Automatically detect and use Intel Quick Sync Video GPU integrated into select Intel processors for hardware accelerated decoding, color correction, and scaling.
    c. Provide the ability to use both NVIDIA and Intel GPUs at the same time and automatically load balance the requests for optimal performance.

d. Provide the ability to show which GPU is used to decode which stream.

13. *Hardware Acceleration Recording Server:* Provide the following hardware acceleration capabilities to offload Recording Server video processing from the computer CPU to dedicated hardware video processing capabilities:

    a. *NVIDIA GPU:* Automatically detect and use all available NVIDIA GPUs, for hardware accelerated decoding to enable server-side motion detection.

    b. *Intel Quick Sync:* Automatically detect and use Intel Quick Sync Video GPU integrated into select Intel processors for hardware accelerated decoding to enable server-side motion detection.

    c. Provide the ability to use both NVIDIA and Intel GPUs at the same time and automatically load balance the requests for optimal performance.

14. *Hardware Acceleration Mobile Server:* Provide the following hardware acceleration capabilities to offload Mobile Server video processing from the computer CPU to dedicated hardware video processing capabilities:

    a. *NVIDIA GPU:* Automatically detect and use all available NVIDIA GPUs, for hardware accelerated decoding to enable adaptive transcoding.

    b. *Intel Quick Sync:* Automatically detect and use Intel Quick Sync Video GPU integrated into select Intel processors for hardware accelerated decoding to enable adaptive transcoding.

    c. Provide the ability to use both NVIDIA and Intel GPUs at the same time and automatically load balance the requests for optimal performance.

15. *Open Network Bridge Functionality:* Provide access to live and recorded video, and the ability to control pan-tilt-zoom cameras in compliance with the relevant ONVIF Profile G and Profiles S standards.

16. *Camera-Independent Motion Detection:* Provide real-time, camera-independent motion detection with:

    a. *Configurable Sensitivity:* Configurable and automatic motion-detection sensitivity per camera

    b. *Searchable Metadata:* Searchable motion detection metadata created during motion detection.

    c. *Exclusion Zones:* Multiple motion exclusion zones definable per camera to keep irrelevant motion from triggering recording.

17. PTZ Control Priorities:

    a. Provide 32,000 PTZ priority levels for control of rights between different operators and automatic scanning and patrolling schemes.

    b. PTZ Scans and Patrols shall pause for higher-priority manual or event-based camera control, and resume after manual session timeout and completion of event camera control period.

18. *Configurable Pre-Buffering:* Provide pre-buffering with variable buffer length, with the ability to place buffer on disk or in memory.

19. *Device Video Quality Optimization:* Provide video quality optimized per available bandwidth, device screen resolution, and camera view window sizes in these clients:
    a. XProtect Smart Client Optimization:
        1) Switch between all configured live video streams from the cameras to optimize bandwidth consumption and workstation performance.
        2) Optimize viewing performance for remote viewing according to the available bandwidth and view layouts, maximizing video stream quality per display capabilities of defined views.
    b. *XProtect Web Client and XProtect Mobile Client Optimization:* Optimize transcoding by capping video stream resolution and frame rate for transmission to XProtect Web Client and XProtect Mobile client.
20. *Multicasting:* Provide optimization of network load in systems with many users viewing the same camera live, by sending one video stream per camera to multiple XProtect Smart Client and XProtect Smart Wall instances.
21. *Multiple Language Support:* Provide support for multiple languages in these XProtect clients:
    a. *Management Client User Interface:* American English, Chinese (Simplified), Chinese (Traditional), Danish, French, German, Italian, Japanese, Korean, Portuguese (Brazilian), Russian, Spanish, Swedish and Turkish.
    b. *Management Client Built-In Help:* American English, Chinese (Simplified), French, German, Japanese, Korean and Portuguese (Brazil).
    c. *XProtect Smart Client, XProtect Web Client and XProtect Mobile Client User Interface:* American English, Arabic, Bulgarian, Chinese (Simplified), Chinese (Traditional), Croatian, Czech, Danish, Dutch, Farsi, Finnish, French, German, Hebrew, Hindi, Hungarian, Icelandic, Italian, Japanese, Korean, Norwegian (Bokmål), Polish, Portuguese (Brazilian), Russian, Serbian, Slovak, Spanish, Swedish, Thai, Turkish and Ukranian.
    d. *XProtect Smart Client Built-In Help:* American English, Arabic, Chinese (Simplified), Chinese (Traditional), Czech, Danish, Dutch, French, German, Italian, Japanese, Korean, Polish, Portuguese (Brazilian), Russian, Spanish, Swedish and Turkish.
    e. XProtect Web Client and XProtect Mobile Client Built-In Help: American English, Danish and Japanese.
22. *True Multi-Window Support:* Provide true multi-window support in XProtect Smart Client whereby secondary windows have full functionality and can be operated in independent mode or synchronized mode where they follow the control of the main window.
23. *SNMP Agent:* Provide VMS functionality to act as SNMP agent that can generate an SNMP trap upon rule activation.
24. *System Capacities:* Provide the following maximum capacities, constrained only by the physical performance capabilities of installed server hardware and network infrastructure:

a. Unrestricted devices.

b. Unrestricted client software users.

c. Unrestricted mobile devices.

d. Unrestricted client PCs or laptops.

e. Unrestricted servers.

f. Unrestricted Smart Walls, with an unrestricted number and combination of display monitors.

g. Unrestricted sites.

h. Unrestricted system rules.

i. Unrestricted time profiles.

j. Unrestricted software client profiles.

k. Unrestricted media storage.

l. Recording rates of at least 30 FPS per camera, limited only by hardware capabilities.

C. System Security

1. *Control and Information Security:* Provide the following data protection measures and user rights management capabilities in support of system confidentiality, integrity and availability:

a. *Data in Transit:* Encrypted communication between servers and clients using secure communication CA digital certificates.

1) HTTPS connections from Recording Server to devices that support HTTPS connections.

2) Encrypted communication between the Recording Server and services that retrieve streaming data using customer-provided CA digital certificates for connections to the Recording Server.

3) Encrypted communication between the Management Server and the Recording Server using customer-provided CA digital certificates.

4) HTTPS connections from VMS clients, SDK clients and services that support HTTPS connections to Recording Server.

b. *System Configuration Data*: Provide password protection of the system configuration backup.

c. *Media Data at Rest Integrity and Encryption*: Provide the ability to use password-based protection, including encryption and digital signature settings, per media storage container.

1) Two modes of video database encryption using 256-bit AES encryption:

a) *Light Encryption.* Encrypts only the first part of the MJPEG or MPEG-4/H.264 video, audio and metadata, to use less processing power for encrypting the video. Video cannot be decoded without the information contained in the encrypted header.

b) *Strong Encryption.* Encrypts all parts of the video, audio and metadata stored in the database.

2) Digitally signed media databases with SHA-2 algorithm to establish a means of detecting modification of stored video, audio and metadata.

d. *Off-Premises Live and Recorded Video in Transit*: HTTPS connections must use trusted CA certificates and support HTTPS connections from:

1) Mobile Server to browser-based XProtect Web Client and XProtect Mobile client app.

2) Open Network Bridge to remote public systems.

e. Data Integrity of Exported Video:

1) Export video in XProtect format that can only be viewed in the XProtect Smart Client — Player.

2) Per-export password protection for playback.

3) 256-bit AES encryption.

4) Digitally signed media exports with SHA-2 algorithm to establish a means of detecting modification of exported video.

5) Include any digital signatures applied in the media database.

6) XProtect Smart Client — Player's Verify Signatures function to validate authenticity of exported video recording.

7) Option to prevent re-export of exported video.

f. *Digital Certificates:* Use of customer-provided CA digital certificates for connections to the Mobile Server.

g. Data Access Control: Provide:

1) User profiles restricting device access and video viewing, playback and export, including by day and time-of-day.

2) Timestamped audit log of who logged in, viewed live or recorded video, or exported video.

2. User Authentication:

a. *Log-in Options:* Log-in authentication via:

1) Microsoft Active Directory.

2) Local Windows user accounts.

3) External IDP using Open ID Connect to facilitate single sign-on.

4) Basic user system account (username and password credentials).

a) Ability for basic user to change password during login.

b) Ability for system administrator to enforce password change during login.

c) Ability to enforce password complexity.

5) Dual authentication, a.k.a. two-person rule, requiring two verified persons to gain access.

b. *Auto-Log-In:* Use of last used credentials for authentication, with Auto-log-in and auto-restore of camera views.

c. *Kerberos Authentication:* Provide strong authentication via Kerberos support.

3. *User Rights Management:* Provide common and central detailed management of user rights across all user and programmatic (SDK) interfaces, using roles, users, and user groups:

a. *Tiered User Rights:* Assign partial management of permissions to system administrators using the Management Client.

b. *User Rights:* Define roles, add and delete users, manage permissions for roles, user groups and users, generate user rights management reports. Tiered user management rights shall enable differentiated administrator rights per administrator role.

c. *User Rights Inheritance:* Create sub-management domains where management of a specific set of devices can be assigned to a specific system administrator.

d. *Roles:* Defining roles establishes permissions (also called “rights”) that determine which system features may be accessed by users and groups. Provide the following security settings for roles:

1) Role Info:

a) *General:* Management Client profiles, Smart Client profiles, evidence lock profiles, dual authorization rights, system log-in time profile.

b) *Applications:* Login to XProtect Smart Client, XProtect Web Client and XProtect Mobile client.

c) *Anonymous PTZ Sessions*: Enabling anonymous user information for PTZ sessions.

2) *Users and Groups*: Users and groups can be assigned to multiple roles.

3) *Overall System Permissions:* Globally allow or deny permissions for servers, devices and functions (such as manage, read, edit and delete).

4) *Specific System Permissions:* Allow permissions for specific individual devices and functions:

a) *Cameras:* Visibility, live view (within time profile), playback (within time profile), search sequences, smart search, export, manual recording, bookmark functions, AUX commands, evidence lock functions.

b) *Microphones and Speakers:* Visibility, listen to live audio (within time profile), playback audio (within time profile), search sequences, export, manual recording, bookmark functions, evidence lock functions.

c) *Inputs and Outputs:* Visibility, activation.

d) *PTZ Control:* Manual control, activate PTZ presets, PTZ priority, manage PTZ presets and patrolling, reserve and release PTZ session.

e) *Speech:* Speak to speakers, speak priority.

f) *Remote Recordings:* Retrieve remote recordings.

g) *Smart Wall:* Visibility, edit, delete, operate, playback.

h) *External Events:* Visibility, edit, delete, trigger.

i) *View Groups*: Visibility, edit, delete, operate.

j) *Servers:* Professional server access and authentication details, Milestone Federated Architecture site permissions.

k) *Matrix*: Visibility.

l) *Alarms:* Manage, view, disable alarms, receive notifications.

m) *MIP:* Milestone Integration Platform plug-in permissions.

4. *Client Authentication:* Provide Management Server authentication and authorization of connecting clients (XProtect Smart Client, Management Client and MIP SDK clients) and use a session-limited access token for controlling access to the Recording Server.

5. *System Hardening:* System hardening guide that:

   a. Describes data security, network security and physical security measures and best practices for securing the installed VMS against cyber-attacks. This includes security considerations for the hardware and software of servers, clients and network device components of a video surveillance system.

   b. Incorporates standards-based and best-practice-based security and privacy controls and maps them to each hardening recommendation.

6. *GDPR:* The system must facilitate compliance to GDPR:

   a. *GDPR-Ready Certification*: The VMS must have a European Privacy Seal from GDPR ready certificate.

      1) The vendor shall provide comprehensive guides and templates to aid in configuring a GDPR compliant system.

      2) The vendor shall have a clear and concise privacy policy.

   b. The system shall provide warnings when use of the system is at risk of going outside GDPR compliance.

   c. *Privacy by default*: The VMS must have privacy settings set by default.

      1) The system shall have audio data processing disabled by default.

      2) The system shall have metadata, recording, transmission, and other processing disabled by default.

      3) The system shall have online map services disabled by default.

7. *FIPS 140-2 compliant mode*: The VMS has the ability to operate in a FIPS 140-2 compliant mode.

D. Logging

1. Provide logging of errors, warnings, system information, user activity, and logs about rules to a centralized database with time, date, and other related information. Logs provide multi-system support and configurable logging limits.
    a. *System Logs:* Log all system related errors, warnings and system information, to be used for troubleshooting.
    b. *Audit Logs:* Log user activity in client applications including, but not limited to, user system access, configuration changes and operator actions.
    c. *Rule-Triggered Logs:* Log rules in which the system administrator has specified the “Make new log entry” action.
    d. *Log Exporting:* Logs can be exported as comma-separated-values (.csv) files.
    e. *Log Filtering:* Logs can be filtered based on time frame, source name, source type, user, user location, rule name, etc.
    f. *Log-Related Options:* Settings can be changed about:
        1) Log retention time.
        2) Which levels (error, warning, and system information) are logged.
    g. Log security.

E. System Functionality

1. Configuration Management:
    a. *Real-Time Configuration Change Application:* Immediately apply authorized changes of system configuration data for all sites, including, but not limited to licenses, devices, rules, schedules, users, maps, alarms, recording, client views, including while recording is in operation.
    b. *Configuration Data Caching for Continued Operation:* Cached Recording Server configuration data shall ensure continuous operation of Recording Server during periods where the Management Server is inaccessible.
    c. *Backup and Restore:* Built-in backup and restore support for manual system backup of all configuration data, including but not limited to:
        1) All system configuration data.
        2) Full device configuration data.
        3) Maps.
        4) Alarm settings and definitions.
        5) Software client views.
        6) User-defined rules, events and dashboard customizations.
        7) Defined video bookmarks.
    d. *Configuration Reporting:* Provide complete or partial documentation of system configuration, including custom and site-specific free-text information, contractor’s notes and option for logo inclusion.

2. Customizable Built-in System Monitor:
    a. *System Dashboard:* Dashboard display containing detailed and up-to-date information about current servers and cameras. Dashboard displays include the following items:
        1) *Server Tiles*: Displays the status of individual or groups of servers via colored tiles.
        2) *Camera Tiles*: Displays the status of the cameras via colored tiles.
        3) Details on monitoring parameters are shown when a tile is selected.
        4) *Monitoring Parameters:* Customizable Normal, Warning and Critical system monitor and event triggers for:
            a) General Server Information:
            b) CPU usage.
            c) Memory available.
            d) Recording Server Information:
            e) CPU usage.
            f) Memory available.
            g) Free space.
            h) Retention time.
            i) Camera Information:
            j) Live FPS.
            k) Recording FPS.
            l) Used space.
    b. *System Details:* Detailed real-time display and reporting of system performance and conditions for:
        1) General Server Information:
            a) CPU and memory usage.
        2) Recording Server Information:
            a) CPU and memory usage.
            b) Pie-chart status information for the storage elements on each hard drive: video recordings and archives; other data, including video archives from other archive storage locations (such as network drives); free space, disk size.
            c) Network adaptor usage.
            d) Storage container usage.
            e) Camera information.
        3) *Camera Information*: A table containing:
            a) General status.

b) Recording status.

c) Camera name.

d) Storage container used.

e) Used space.

f) Live FPS.

g) Recording FPS.

h) Live video format.

i) Recording video format.

j) Media data received.

4) *Historical Reporting*: On-screen and PDF report of historical performance data going back 30 days.

c. *Monitoring Multiple Servers and Federated Systems*: Provide multiple dockable tabs in XProtect Smart Client with system performance and use information for different servers and federated systems.

3. Application Workspace Optimization:

a. Options for optimizing application workspaces in the Management Client software:

1) *Application Layout*: Rearranging layout via drag-and-drop.

2) Management Client Profiles:

a) Centralized management of application options for optimization application for different user categories and skill levels.

b) Ability to tailor the availability of main/sub functions for different user roles.

b. Options for optimizing application workspaces in the XProtect Smart Client software:

1) *General*: Control general look and feel and navigation properties, such as color mode, camera title bar, grid sizes.

2) *Personal or Centrally Enforced*: Optimization can either be made as individual personalization managed by each operator, or centrally enforced using Smart Client profiles.

3) *View Layouts:* Availability of specific view layouts enforced using Smart Client profiles.

4) *Themes:* User interface color schemes enabling user choice of dark or light themes.

5) *Control Panes Availability*: Control availability of control panes and functions in live and playback tabs, and in setup mode.

6) *Timeline Information*: Control information included in timeline in playback tab.

7) *Export Behavior*: Control behavior and availability of export function.

8) *Keyboard and Joystick Setup*: Setup of keyboard short cuts and joystick controls.

9) *Alarm and Access Control Notifications*: Control behavior of alarms and access control notifications.

10) *Application Language*: Control application language.

11) *Advanced Application Settings*: Control advanced application settings such as use of multicast, hardware acceleration, adaptive streaming, videos diagnostics overlay and time zone settings.

4. Device Discovery and Management:

   a. Add Hardware wizard to automatically discover and upon approval add devices to system using Universal Plug and Play (UPnP) discovery, IP network range scanning, or manual device detection. User ability to perform initial setup of credentials on devices without factory default credentials detected. Must be supported for Axis, Bosch, Hanwha Techwin, and for ONVIF profile Q conformant devices.

   b. Replace Hardware wizard for swift replacement of malfunctioning devices with preservation of configuration settings and recordings, including those for attached cameras, microphones, speakers, inputs, outputs and metadata devices.

   c. Move Hardware wizard for moving devices and related devices from one Recording Server to another during runtime with no loss of settings, recordings, rules, permissions etc.

   d. User ability to enable and disable devices for purposes of maintenance or temporary deactivation.

   e. User ability to change the password of one or multiple devices based on a pre-configured time interval. Must be supported for Axis, Bosch, Canon, Hanwha Techwin, Hikvision, Panasonic, Sony and ONVIF-compliant devices.

   f. User ability to see the firmware version of each device.

   g. User ability to update information about the firmware and features available for a device.

   h. User ability to upgrade the firmware of one or multiple devices, based on groups of devices. Must be supported for Axis, Bosh, Hanwha, Techwin and ONVIF.

   i. For ONVIF Profile T & Q compliant devices. User ability to manage a VMS user account that communicates with a device. Add a user, list an existing user, and delete a user.

   j. For ONVIF Profile T & Q compliant devices. User ability to manage network configuration. Change IP address, subnet mask, and default gateway.

5. *Camera Image and Video Stream Management:* Adjustment of per-camera and per-video stream settings, with each camera allowed one or more streams for live viewing and one stream for recording, including an optional per-camera or per-camera-group preview window:

   a. Per Camera:

1) *General Settings*: Change all camera specific general settings such as brightness, color level, compression, maximum bit rate, resolution and image rotation.

2) *Camera Video Stream Settings*: Define as many different streams as specific camera support. Change individual stream settings such as FPS, resolution, image quality, video encoding format and resolution.

b. Per Camera Group:

1) *General Settings*: Change all common camera specific general settings for the camera group such as brightness, color level, compression, maximum bit rate, resolution and image rotation.

2) *Camera Video Stream Settings*: Define as many different streams as specific camera support for the camera group. Change individual stream settings such as FPS, resolution, image quality, video encoding format and resolution.

3) One camera can be associated to multiple camera groups.

c. *Video Streams:* Define one camera video stream used for recording and multiple cameras video streams to be used for live viewing.

d. *Recording*: Manage recording functionality including:

1) Related device recording.

2) Manual recording timer.

3) Pre-buffer use.

4) Recording framerate.

5) Media storage assignment.

6) Automatic retrieval of edge recordings.

e. *Fisheye Lens Viewing:* Capability for fisheye lens camera views provided through utilization of the ImmerVision Enables panomorph lens technology. Other lenses than ImmerVision can be supported by using a generic dewarping lens profile or a third-party plug-in.

f. *Motion Detection*: Manage motion detection functionality including:

1) Motion sensitivity.

2) Processing all frames or keyframes only.

3) Generation of motion metadata for smart search.

4) Exclusion zones.

g. *Camera Events*: Define which camera events will be forwarded to the VMS.

1) *Client Settings*: Define client related functionality including:

2) Use multicast for live stream.

3) Related devices.

4) Keyboard shortcut.

h. *Privacy Masks:* Permanent and liftable system-defined camera image privacy masks hide certain areas in the camera image for live view, recording, and video export.

1) Permanent Masks: Allow a system admin to mask areas in cameras at all times and for all users. Permanently masked areas cannot be revealed once recorded.

2) *Liftable Masks:* Allows a system admin to establish default mask areas in cameras at all times and for all users, but with the option to sufficiently privileged operators to temporarily remove the masks for authorized users if needed – such as during investigation.

3) *Masking Level:* When establishing a privacy mask, system admins may select a mask level on a scale between 'light blur' to 'solid grey'.

6. *PTZ Camera Control:* Camera-based and system-based PTZ camera control including the following capabilities.

a. *Camera PTZ preset positions:* Camera-based PTZ presets may be imported from the camera and renamed for use in system-based manual and automatic PTZ control.

b. *Automated Use of PTZ Presets:* Scheduled and event-based rules capability to move PTZ cameras to pre-set positions.

c. *System-Based PTZ Preset Positions:* System-based PTZ presets are definable for use in system-based manual and automatic PTZ control.

d. *PTZ Patrolling:* Multiple per-camera PTZ patrolling schemes may be defined with the following options:

1) Adjustable wait times between preset position changes.

2) Disabling of motion detection to avoid false detection alarms.

e. Multiple patrolling schedules per camera per day, with different schedule for days, nights and weekends.

F. Event and Alarm Management

1. *Rules Engine:* Provide rules for automating of different aspects of the system, including camera control, system behavior and external devices, based on events or time profiles, or a combination of events and time profiles.

a. *Trigger Events:* Provide a Microsoft-Outlook-style configuration dialog where pre-defined and custom-defined events are used in rules to trigger actions.

1) *Event Categories:* Organize events into the following categories:

a) *Hardware:* Physical hardware devices connected to the system.

b) *Devices:* Certain functions and states of devices available via connected hardware devices.

c) *External:* Relating to VMS integrations.

d) *Recording Server: A*rchiving, failover and database functions.

e) *Analytics:* From integrated analytics applications and systems.

f) *User-Defined:* Custom-configured events enabling users to manually trigger actions and events in the system.

b. *Start Actions:* Triggering events may initiate a wide set of system actions, including, but not limited to:

1) Control start and stop of recording, including scheduled and event-based recording.

2) Change camera stream properties.

3) Change of Smart Wall content and layout.

4) PTZ camera preset positions and patrols.

5) Event-based notifications, including email notifications to single or multiple recipients with optional attachment of a camera still image or AVI video clip.

6) External system interactions.

7) Bookmark creation.

8) Play pre-recorded audio.

9) Retrieve video and audio from edge storage devices and video from interconnected systems.

10) Single rule allows for executing multiple system actions.

11) Rule actions shall be triggered by event, time interval or a combination of event and time.

12) Rules shall be optionally stopped by event or after a specified time.

13) Unrestricted number of rules.

2. *Time Profiles:* Provide the following time profile functionality for use with profiles, rules and triggers:

a. Dynamic day-length time profile that follows daylight changes over a year including Daylight Savings Time for a given location defined by a GPS position.

b. Time profiles contain one, or more, single or recurring periods of time.

c. Asingle time period may span one or more days, defined by a starting date and time and an ending date and time.

d. A recurring period of time is defined as a time range with recurrence pattern and range:

1) Time range is a starting and ending time within a day.

2) Recurrence pattern may be Daily, Weekly, Monthly or Yearly.

3) Recurrent range is a starting and ending date, or a starting date with a duration in days.

e. Unrestricted number of time profiles.

3. *Single-Point Event/Alarm Management:* Provide central management of all internal system alarms and external security alarms. Events are pre-defined or

user-specified incidents on the VMS that can be set up to trigger an alarm, including analytics events and manual control actions. Event and alarm management capabilities shall include but not be limited to:

a. Alarm Data Settings:
    1) Customizable alarm priorities, statuses and categories to enable alignment of the alarm handling workflow with existing workflows and security systems.
    2) Optional sound notifications for different alarm priorities for notification of new incoming alarms.
    3) Manage which alarm priorities trigger desktop notifications for alarms.
    4) Manage which alarm data are shown in the Alarm Manager, including but not limited to:
        a) ID.
        b) Image.
        c) Location.
        d) Message.
        e) Owner.
        f) Priority Level.
        g) Source.
        h) State Level.
        i) State Name.
        j) Time.
    5) Optional Reasons for Closing to be chosen when an alarm is closed.
    6) Add audio files in wav-format to be used as alarm notification sounds.
    7) Manage how long alarms instances are kept in the system before being automatically deleted.

b. Alarm Configuration:
    1) User-definable alarm descriptions and work instructions.
    2) Select triggering event and source.
    3) Alarm time profiles specifying that response actions must take place within the specified time profile.
    4) Select start and stop events specifying that response actions must take place within the specified event window.
    5) Select a user defined event to be triggered if an alarm is not acknowledged within a defined time limit.
    6) Association of alarms with one or more cameras, with automatic display of camera video in the alarm preview window, with a minimum of 15 cameras showing simultaneously in the alarm preview window.

7) Association of alarms to maps.
8) Association of initial alarm owner (individual user or group) and priority.
9) Association of alarm category.
10) Select user defined event to be triggered by the alarm.
11) Enable or disable desktop notifications for alarms.

c. Alarm Manager:
1) Alarm list with extensive sorting and filtering capabilities.
2) Instant preview of recorded video from primary and related cameras, at the time of the incident.
3) Thumbnail image from primary camera, at the time of the incident.
4) Alarm disabling option shall enable users to suppress alarms from a given device for a specified time period.
5) Common alarm list for all interconnected systems and cameras.
6) Common alarm list for all sites in a Federated Architecture.
7) Alarm handling reports providing information about alarm inflow and alarm handling performance.

d. Alarm Handling:
1) Instant preview live video of primary camera.
2) Instant preview of recorded video from primary and related cameras, at the time of the incident.
3) Option to select any related cameras to be displayed in the live and playback view items.
4) Present the alarm work instructions.
5) Change priority and status of the alarm.
6) Alarm escalation with option to forward alarms to operators with appropriate skills to handle specific types of alarms.
7) Present time logged alarm activities.
8) Add time logged comments to the alarm incident.
9) Desktop notifications shall allow immediate access to alarm handling.

e. Map Integration:
1) Present incident location automatically on the map allowing operators to view and acknowledge active alarms.
2) All other map functionality must be available when viewing maps in the Alarm Manager.

f. Smart Map integration:
1) Present incident location automatically on the smart map allowing operators to view and acknowledge active alarms.

g. Cameras with active alarms shall be visualized when viewing the geographic location of search results in the Centralized Search workspace. *XProtect Web Client*: Provide the following alarm list, alarm handling and investigation functionality:

1) Alarm List:

a) Alarm list with filtering capabilities:

b) All or personal alarms.

c) All or specific alarm states.

d) All or specific alarm priorities.

e) Thumbnail image from primary camera, at the time of the incident.

f) Click to handle alarm.

2) Alarm Handling:

a) Instant preview of recorded video from primary and related cameras, at the time of the incident. Available incoming audio for cameras that have related microphones.

b) Present the alarm work instructions.

c) Change priority and status of the alarm.

d) Alarm escalation with option to forward alarms to operators with appropriate skills to handle specific types of alarms.

h. *XProtect Mobile Client*: Provide the following alarm notification, alarm list, alarm handling and investigation functionality:

1) *Alarm Notification*: Receive alarm notifications using Push Notifications. Notifications include access to:

a) Video.

b) Alarm information.

c) Work instructions.

2) Alarm List:

a) Alarm list with filtering capabilities:

b) All or personal alarms.

c) All or specific alarm states.

d) All or specific alarm priorities.

e) Thumbnail image from primary camera, at the time of the incident.

f) Click to handle alarm.

3) Alarm Handling:

a) Instant preview of recorded video from primary and related cameras, at the time of the incident.

b) Present the alarm work instructions.

c) Change priority and status of the alarm.

i. Alarm escalation with option to forward alarms to operators with appropriate skills to handle specific types of alarms.

G. Video Processing and Viewing

1. *Multiple Monitor Support*: Support multiple monitors where each monitor shall show multiple floating or full-screen windows for display of views or individual view items.
2. *View Window Aspect Ratios:* Support multiple views optimized for 4:3 and 16:9 display settings in both landscape and portrait orientations.
3. *Private or Shared Views:* Private views can only be access by the user who created them. Views may be shared generally and available to all roles or restricted to specific roles. Viewing of a content item in a shared view is subject to the viewer's permissions relating to the content item.
4. *View Groups:* View groups facilitate view navigation and simplify searching across multiple views by narrowing search scope.
5. *View Layout Persistence*: Same view layout in both live and playback modes.
6. *View Arrange and Restore:* Support simple drag-and-drop re-arrangement of cameras in views for optimized monitoring of incidents, including replacement of individual cameras with different cameras, with single-click restore of original view layout.
7. *View Creation:* Views that display up to 100 view items including cameras, web pages, still images, text and interactive items. View capabilities include, but are not limited to:
    a. *Camera View Item:* Live and recorded camera video displayed in resizable view windows, utilized in several workspaces within the application. Each camera view item contains the following:
        1) *Video Status Indicator:* A round dot indicating one of four states:
            a) *Green:* A connection to the camera is established.
            b) *Red:* Video from the camera is being recorded.
            c) *Yellow:* Playing back recorded video.
            d) *Gray:* The video has not changed for more than two seconds.
        2) *Motion Indicator:* An icon of a moving person that appears only when motion is detected since it was last cleared.
        3) *Bounding-Box Display:* Display of metadata bounding boxes as provided by supported cameras and integrated analytics in live and playback views.
        4) *Update on motion only:* Optimizes CPU use by allowing motion detection to control whether the image should be decoded and displayed.
        5) *PTZ Camera View Item:* PTZ camera view item can be configured to provide virtual joystick camera control and PTZ navigation overlay buttons on the video image.

6) *Overlay Buttons:* Used to add manually controlled speakers, events, outputs, PTZ cameras and to start/stop recording.

b. *Carousel:* Allow a specific view item to automatically sequence rotate through pre-defined set of cameras that are not necessarily present in the view at the same time. Operators may select default or custom display times for each camera, and they are able to manually switch to the next or previous camera in the carousel list.

c. *Hotspot:* Global hotspot function shall allow users to work in detail with any camera selected from any view. Local hotspot function shall allow users to work in detail with a camera selected from the same view.

d. *HTML Page*: Show interactive HTML page.

e. *Image:* Show a still image.

f. *Matrix:* Shows live video from multiple cameras in any view layout with customizable rotation paths, remotely controlled by the computers sending matrix remote commands.

g. *Navigable Map Pages:* Static or active map pages may be used to provide a good overview of premises, and for switching between different views, such as map page displaying a floor plan.

h. *Smart Wall*: Display Smart Wall control providing the following functionality:

1) Show monitor layout of currently selected Smart Wall.

2) Drag-and-drop views to any monitor.

3) Drag-and-drop cameras to any view item location in any monitor.

4) Change Smart Wall via dropdown.

5) Activate Smart Wall preset via dropdown.

i. *Text*: Add text.

j. *3rd party plug-ins*: Add 3rd party plug-ins to extend the behavior of XProtect Smart Client.

8. *Live Video*: Views provide camera live viewing capabilities including, but not limited to:

a. *Live Viewing:* View live video of camera view items on the Live tab.

b. *Manual PTZ Control:* Manual PTZ control options:

1) Video overlaid PTZ control.

2) Joystick.

3) Virtual joystick function.

4) PTZ point-and-click control.

5) Reserve and release PTZ control.

6) PTZ preset positions.

7) Overlay buttons to activate PTZ preset positions.

8) PTZ zoom to a defined rectangle.

9) Start, stop, and pause patrolling.

10) View who have PTZ control and time to automatic release, including anonymous users.

c. *Stream Selection*: Change to any defined live video stream.

1) Manual selection of defined live video stream.

2) *Adaptive Streaming*: Automatic selection of defined live video streams with the best match to the requested resolution.

d. *Send Video to Destination*: Option to send current camera to the following destinations:

1) View item in an existing window.

2) New floating window.

3) View item in any defined Smart Wall.

e. *Digital Zoom:* Magnification of video to facilitate detail viewing.

f. *Bookmarks:* Create quick or detailed bookmarks, to facilitate incident review and documentation.

1) System generated headline for quick bookmark.

2) Optional headline and description information for detailed bookmark.

g. Independent Video Playback:

1) Playback of video in multiple camera view items, each on its own independent timeline.

2) Option to initiate playback mode and synchronizing playback timeline with current time in independent playback.

h. *Instant Change of Camera:* Drag-and-drop placement of a different camera in a camera view item, instantly changes the content to video from the new camera, according to the camera view item's current timeline position.

i. *Smart Map*: Enable quick navigation to smart map, showing the geographic location of the camera, even camera located on a specific level inside a multistory building.

j. *Centralized Search*: Initiate Centralized Search for the camera in a new window.

k. *Manual Recording*: Start and stop manual recording with automatic stop of recording after a configurable number of minutes.

9. *Video Playback:* Views provide additional camera playback capabilities including, but not limited to:

a. *Playback:* Time synchronized play back video of camera view items on the Playback tab.

b. *Navigation:* Advanced video navigation includes:

1) Forward and backwards playback at different speeds:

a) *Playback Speeds*: ¼x, ½x, 1x, 2x, 4x, 8x, 16x.

b) *Instant Realtime Speed*: Toggle 1x playback speed or selected playback speed.

2) Forward and backwards frame-by-frame.

3) Skip to next or previous recorded sequence.

4) Skip to beginning or end of recordings.

5) Jump to date/time.

c. *Timeline:* An overview of recorded sequences and bookmarks via integrated video timeline with time navigation and playback controls, including the following functionality:

1) *Timeline Video Playback:* Video from multiple camera view items integrated to a common video timeline, with common timeline control from any of the integrated camera view item.

2) *Single and Consolidated Timeline*: Two timelines with the first showing overview of selected camera view item and second showing a consolidated overview of all camera view items in the view.

3) *Timeline Period*: Select which period timeline covers.

a) 5, 10, 20 minutes.

b) 1, 2, 4, 8, 12, 16, 20 hours.

c) 1, 2, 4 days.

d) 1, 2, 4 weeks.

4) *Recorded Sequences Overview*: Recorded sequences of video and audio are shown in the timeline. The timeline displaying light-red to indicate recording, red for motion, light-green for incoming audio, and green for outgoing audio. If there are additional sources of data available, these are displayed as other colors.

5) *Bookmarks Overview*: Bookmarks are shown in the timeline with instant preview of the recorded video.

6) *Integrated Time Interval Selection*: Integrated function to select a time interval for export, evidence lock or video and audio retrieval from edge storage devices and interconnected systems.

a) Visual selection on timeline.

b) Select start and end date/time.

c) Loop selected period on playback.

7) *Multi-Window Timeline*: Ability to use one timeline to control playback of cameras in multiple view windows.

d. *Recording Search:* Search listing of camera sequences or bookmarks.

1) *Preview*: Search results may be previewed.

2) *Print*: Print of still image from the selected video clip may be initiated.

3) *Export:* Export of selected video clips may be initiated, reducing time needed to prepare forensic video material.

10. *Send View Item to Smart Wall*: Option to send current view item content to any defined Smart Wall.
    a. *Smart Map*: Send smart map to Smart Wall with the current geographic location, zoom level, and layers.
11. *Two-Way Audio:* Audio from cameras with built-in or attached microphones can be configured for listening. Camera built-in or attached speakers can be configured for use to talk to individuals near speakers. Additional capabilities include:
    a. *Broadcast:* Broad announcements can be made by selecting the All Speakers option when talking.
    b. *Lock to Selected Audio Devices:* Enables continued use of microphones and speakers from selected cameras, while viewing video from a different set of cameras. This enables, for example, informing an individual at risk about the safety status of nearby areas.
    c. *Level Meter:* Level meter indicates the volume of the speaking operator's voice, to indicate whether the operator is at a correct distance from the microphone.
12. *Centralized Search:* Shall enable users to apply multiple search categories and filters to find recording sequences, bookmarks, recordings with motion, alarms, events, vehicles, people, location and data from third-party systems. Logical operators shall enable users to match any or all the search categories. From the search results, users shall be able to preview video and perform various actions, e.g. by exporting the search results or sending the search results to PDF. The search results shall be presented instantly as thumbnail images:
    a. *Sequence Search:* Search in recording sequences on one or more cameras.
    b. *Motion Search:* Search for sequences with motion, or Smart Search for motion in selected areas on one or more cameras.
    c. *Bookmark Search:* Search for bookmark headlines or descriptions.
    d. *Alarms and Events Search:* Search for alarms and events, with the ability to apply filters to refine the search results.
    e. *Location Search:* Search for recording sequences recorded at specific geographic locations. Shall only be available for cameras that provide ONVIF compliant video streams containing metadata about location.
    f. *People Search*: Search for people, with the ability to apply filters to refine the search results, including age, face, gender and height. Shall only be available for cameras that provide ONVIF compliant video streams containing metadata about people.
    g. *Vehicle Search:* Search for vehicles, with the ability to apply filters to refine the search results, including license plate, country code, color, speed, and vehicle type Shall only be available for cameras that provide ONVIF compliant video streams containing metadata about vehicles.

h. *Third-party Systems Search:* Search for metadata from integrated third-party systems.

i. *Sorting By Relevance:* The ability to sort search results by relevance:

1) One or no search categories: The search result with the newest event time shall be displayed first.

2) Multiple search categories combined with logical operator OR: The search result with most matching search categories shall be displayed first.

3) Multiple search categories combined with logical operator AND: The search result with most event times shall be displayed first.

j. *Save Search:* The ability to save searches for reuse:

1) Save searches.

2) Search for and open saved searches.

3) Edit saved searches.

4) Delete saved searches.

k. *Navigation:* Ability to jump to search results through a clickable timeline, or the ability to scroll through the search results.

l. *Preview:* Selected sequence previews with auto play and direct export support.

13. *Video Export and Documentation:* Smart Client options for video export and documentation include, but are not limited to:

a. *Snapshot:* Produce instant visual documentation of a camera by saving the camera image to a file.

b. *Print:* Produce instant visual documentation of a camera by sending it directly to a printer.

c. *Storyboarding:* The storyboarding function makes it possible to include video sequences from different or overlapping time intervals from different cameras in the one and the same export.

d. *Export XProtect Format:* Export in XProtect format; including the standalone XProtect Smart Client — Player application for simple instant viewing by authorities.

e. *Export Preview:* Review video just prior to export, with looped playback option.

f. *Export Other Formats:* Create evidence material in media player format (AVI files), MKV format, or still image format (JPEG images).

g. *Re-Export:* Re-Export allows an authorized individual to export a digitally signed selection from the original video exported. Option to disable re-export, during initial export to XProtect format, prevents undesirable re-distribution of sensitive video recordings.

h. *Bulk Export:* In a single step, export in multiple formats to multiple destinations, including direct export to optical media, to ensure consistency

across exported video sequences in various formats, and reduce human error possibilities.

i. *Export of Comments:* Two video formats support inclusion of comments in exported video:

1) *XProtect Format:* Include general and/or camera-specific comments to a video export file.

2) *Media Player Format:* Include comments as pre/post slides.

j. *Video Incident Report Printing:* Utilize still images rather than clips to print incident reports including images, surveillance details and free-text user comments.

H. Maps

1. *Maps:* Provide multi-layered physical overview of surveillance video coverage, with interactive access to and control of the VMS and related devices, including the following elements:

a. *Map Images:* Illustrated maps or photographs. Supported image file formats are: BMP, GIF, JPEG, JPG, PNG, TIF, TIFF, and WMP.

b. *Camera Icons:* Indicate camera locations on the map. Fixed camera icons show camera view as colored angle radiating from the camera. PTZ camera icons show preset camera views as colored angles radiating from the camera.

1) *Live Preview:* Hover mouse pointer over camera icon to display a live preview in a resizable window.

2) *PTZ Preset Navigation:* Click on PTZ preset view zone moves camera to the preset position.

c. *Microphone Icons:* Microphone icons show microphone locations on the map.

1) *Live Listening:* Place mouse over microphone icon; press and hold left mouse button to listen to incoming audio from microphone.

d. *Speaker Icons:* Indicate speaker locations on the map.

e. *Live Speaking:* Place mouse over speaker icon; press and hold left mouse button to talk through speaker.

2. *Control Icons:* Icons to use for control of objects such as doors, gates, and lights.

3. *Hot Zones:* Hot zones to provide vertical navigation through a hierarchy of maps by clicking on a hot zone.

1. *Map Overview Window:* Navigable overview of map hierarchy set up in XProtect Smart Client.

2. *XProtect Smart Wall Integration:* Drag-and-drop integration of maps with Smart Wall.

3. *Map Image Updates:* When map images are replaced by an updated version of the map image of the same scale, map icons and other elements are kept in their original locations.
4. *Map Display Information:* Information display options include but are not limited to:
    a. Real-time status monitoring indication from all system components including cameras, I/O devices and system servers.
    b. Graphical visualization of the system status through color coding.
    c. Hierarchical propagation of status indications to higher ordered maps.
    d. Different levels of status indications available (alarm, warning and errors).
    e. System performance data for cameras and servers including camera resolution, FPS, network use and disk space.
    f. Ability to suppress status indications (such as alarms and operational status) for a given device.
    g. Editable device names in map and map-specific names and references assignable to devices in Map, subject to user permissions.

I. *Smart Map:* Provide a geographic information system to accurately reflect geography in the real world, enabling access to cameras, microphones, input devices and alarms at multiple locations around the world. Differentiate from Maps, which utilize a different map for each location, by providing the complete picture in a single view, with seamless drilldown across different map layers. Include the following capabilities:

1. *GIS Map Services:* Supported services shall include Milestone, Bing, Google and OpenStreetMap map services.
    a. *Offline OpenStreetMap Map Service*: Support the use of owner-provided OpenStreetMap server for offline use.
2. *Geo-referenced Map Elements:* Shapefiles, CAD drawings, such as DWG and DXF files, and buildings with multiple floor levels shall be supported.
3. *Default World Map:* Standard world geographic background containing geo-reference data but not containing geographic reference features such as county boundaries, and cities.
4. *Map Layers:* Map data layers whose display may be toggled on and off, including but not limited to: Camera name and field of view, quick links, street names, and building and business names.
5. *Camera Selection:* Capabilities include:
    a. Instant one-click camera preview in floating view of up to 25 cameras.
    b. Easy multi-camera selection within camera preview.
    c. Easy drag-and-drop and point-and-click definition of: cameras, camera field of view. Changing cameras placement, direction and field of view automatically update camera position information.

d. Selection of 10 different camera icons.

e. Depiction of camera field of view on map.

6. *Camera And Device Aggregation:* Aggregated cameras and other devices shall be grouped visually to preserve the overview when multiple cameras or other devices are closely located.

   a. Ability to view the number and types of devices inside the grouping.

   b. Ability to zoom to a zoom level that shows all the cameras and devices inside the grouping, including sub-groupings.

7. *Device Naming:* Administrators may name edit devices in a map and assign map-specific names and references to devices in a map.

8. *Navigation*: Easy drag-and-drop and point-and-click definition of:

   a. *Location Links*: Location links shall enable quick navigation across different sites and locations.

   b. *Quick Links*: Quick links shall enable drilldown to existing classic Smart Client maps.

   c. *Building Navigation*: Navigation between different floors in buildings with multiple levels, where only camera related to the specific floor level are presented.

J. Media Storage Management

1. *Archiving:* Recorded video data may be automatically moved from a container's live database storage to its archived storage. Archived data is still online and available to client software.

2. *Grooming*: Video data grooming possibility to enable reduction of video recording data size by reducing the frame rate of the video data when archiving.

3. *Maximum Recording Times:* Maximum recording times may be set for manual recordings, with VMS deleting older video to free up storage for newer video.

4. *Edge Video Storage:* Provide utilization of camera-based storage including the following capabilities:

   a. *Video and Audio Retrieval:* Retrieving video and audio recordings across low-bandwidth connections based on time profiles, events or manual requests.

   b. *Video and Audio Consolidation:* Consolidating video and audio from multiple storage mechanisms:

      1) Seamless merging of video and audio stored centrally in media database, and video and audio retrieved from associated camera edge storage, or from an interconnected system.

      2) Optionally consolidate pre-event images recorded locally in camera or video encoder.

   c. *Scalable Video Quality Recording (SVQR):* Capability to record high quality video using edge storage and record low quality video centrally, to minimize network bandwidth utilization, using the capabilities described above. High

quality video can be retrieved when needed, on an event-driven, scheduled or manual basis.

5. *Evidence Lock:* Provide capabilities for assuring the availability of recorded video selected for evidentiary use, including:
    a. *Extension of Video Retention:* Manual extension of video retention time for a selected set of cameras, and its related devices, in a given time interval, where the operator selects an extended retention time from a pre-defined set of retention time options.
    b. *Video Sequence Metadata:* Users may add headline and comments information to locked video sequences to enhance their manageability.
    c. *Management of Locked Video Sequences:* Search, filter and listing functions including editing comments, modifying extended retention time and removing an evidence lock.
    d. *Locked Video Export:* Locked video may be exported though a single step operation.

K. XProtect Mobile Server
1. *User Authentication:* Facilitate the following methods of user authentication:
    a. *Basic Authentication:* Basic user VMS account.
    b. *Windows Authentication:* Via Active Directory or local Windows user account. Possible to use current Windows user to facilitate single sign-on.
    c. *Two-Step Verification:* In addition to login capabilities, provide two-step authentication via a verification code transmitted to the user's registered email address, with a five-minute timeout for verification code expiration, and a user login block for exceeding the maximum number of failed code entry attempts, which defaults to three but may be adjusted.
2. *Direct Streaming:* Configure the use of client requested live video streams without server transcoding.
3. *Adaptive Streaming:* Configure the use of automatic live video streams selection depending on the resolution requested by the client.
4. *Dynamic Bandwidth Optimization:* Optimize camera video stream from server to client to make optimum use of bandwidth.
5. *Bookmarks:* Enable the use of bookmarks in live video and recorded video.
    a. *Smart Connect:* Easy configuration of internet access to the Mobile Server by automatic configuration of firewalls and internet routers via UPnP, with verification of configuration and operation of internet connection, with option to email connection details to XProtect Mobile client users. Includes automatic Mobile Server on LAN via UPnP.

L. Xprotect Web Client
1. Provide the following browser-based capabilities:
    a. User Authentication:
        1) Require only username and password.

2) Enable basic users to change password during login.

3) Support two-step verification.

4) User authentication and authorization is handled by XProtect Mobile Server.

b. *Inherit System Views:* Automatically obtain the user's private and shared views configuration from the system.

c. *All-Camera View:* Automatically generate a view for all cameras when no views are set up.

d. *Two-Way Audio:* Audio from cameras with built-in or attached microphones can be configured for listening. Camera built-in or attached speakers can be configured for use to talk to individuals near speakers. Audio playback shall be available for investigations, video exports and alarms. Additional capabilities include:

1) *Broadcast:* Broad announcements can be made by selecting a microphone icon on the view level when talking.

2) *Use the Push-to-talk (PTT) Feature:* Communicate via the VMS system, through a PC microphone and while watching live video from one camera, with people near a video camera with audio equipment. Push-to-talk (PTT) is also available in Actions.

e. *Live Video Monitoring:* View live video with PTZ control including use of presets, video playback, and triggering of camera-related outputs and events from within the camera's view.

f. *Search:* Search function to find cameras, types of camera, cameras with related microphones, cameras with related speakers and camera views.

g. *Video Export:* Provide video export, with the option to preview and store exported video on the server, and make it available for later usage or download, for example, when a higher-bandwidth connection is in use:

1) *AVI, MKV, XProtect Format files:* Ability to create AVI, MKV or XProtect format export files.

2) *Still Image Export:* Provide camera view JPEG image export.

3) *Audio:* Option to include audio in the export package.

4) *Export On Server:* Ability to export on the server to avoid moving large files.

5) *Exceed Retention Time:* Ability to store video recordings for a period that is longer than the retention time.

6) *Play Back Deleted Recordings:* Ability to play back the recordings even if the recordings have been deleted from the media database.

7) *Reduced Download:* Ability to download only needed files or save them for downloading when on a faster connection.

8) *Preview On Server:* Preview exports on the server without downloading them.

h. Data Integrity Of Exported Video:

1) *Encryption And Password Protection:* Option to encrypt and password protect any of the available export formats.

2) *256-bit AES Encryption*: Ability to encrypt exports using 256-bit AES algorithm.

3) *Digital Signature:* Digitally signed media exports with SHA-2 algorithm to establish a means of detecting modification of exported video.

i. *Bookmarks:* Bookmarks shall be applicable for live video and recorded video:

1) Ability to create quick or detailed bookmarks to facilitate incident review and documentation.

2) Ability to edit and delete bookmarks and to use filtering to find bookmarked video.

j. *Secure Connection:* Connect to XProtect Mobile Server through trusted CA certificates for HTTPS encryption.

k. Supported Browsers:

1) Microsoft Edge

2) Safari

3) Google Chrome

4) Mozilla Firefox

l. *Browser Plug-Ins or Extensions*: No plug-ins or extensions to be installed.

M. XProtect Mobile Client

1. Provide the following native-app mobile client capabilities:

a. User Authentication:

1) Require only user name and password.

2) Enable basic users to change password during login.

3) Support two-step verification.

4) User authentication and authorization is handled by XProtect Mobile Server.

b. *Multiple Server Profiles:* Select between multiple server profiles to facilitate easily switching between sites or different connection addresses.

c. Views and View Groups: Automatically obtain the user's private and shared views from the system to be used as camera lists.

1) *View Groups:* Views shall be organized in view group folders. View groups shall also have the capability of organizing subordinate view groups.

2) *All-Camera View:* Automatically generate a view for all cameras when no views are set up.

d. *Two-Way Audio:* Audio from cameras with built-in or attached microphones can be configured for listening. Camera built-in or attached speakers can be configured for use to talk to individuals near speakers. Audio playback shall be available for investigations and alarms. Additional capabilities include:

   1) *Use the Push-to-talk (PTT) Feature:* Communicate via the VMS system, through the microphone of the mobile device and while watching live video from one camera, with people near a video camera with audio equipment. Push-to-talk (PTT) is also available in access control.

e. *Full-Screen View:* Display cameras in full screen to take better advantage of the mobile device's screen, with camera view navigation in full screen by swiping left or right.

f. *Pinch-To-Zoom:* Digital pinch-to-zoom shall enable mobile users to enlarge a part of the image for closer review and conduct detailed investigation of video.

g. *Picture-In-Picture*: Provide the following functionality for Picture-In-Picture:

   1) Display a live picture-in-picture frame of the same camera when in playback mode.

   2) The picture-in-picture shall be movable by dragging.

   3) Double-tapping and will return to live view.

   4) Hide live picture-in-picture frame.

h. *Search:* Search function to find cameras, types of camera, cameras with related microphones, cameras with related speakers, and camera views.

i. *Navigation:* Ability to navigate recorded video using a time picker and to adjust the start time by dragging a timeline scroller.

j. *Bookmarks:* Bookmarks shall be applicable for live video and recorded video.

   1) Ability to create quick or detailed bookmarks to facilitate incident review and documentation.

   2) Ability to edit and delete bookmarks and to use filtering to find bookmarked video.

k. *Mobile Video Push:* Provide XProtect Mobile client capability for mobile device users to use their mobile device cameras as cameras in the VMS, including the following characteristics:

   1) *No Mobile Setup:* No mobile device setup shall be required for mobile video push. Provide central server-side configuration.

   2) *Metadata Support:* Mobile users shall be able to include metadata in the video submitted.

   3) *Audio*: Mobile users shall be able to include audio in the video submitted.

l. *Investigation*: Provide access to investigations created in the XProtect Web Client.

m. *Secure Connection:* Connect to XProtect Mobile server through trusted CA certificates for HTTPS encryption.

n. Supported Mobile Operating Systems:

1) Android

2) iOS

N. SDK-Based Integration

1. *Milestone Integration Platform Software Development Kit (MIP SDK)*: The VMS shall support a software development kit (*MIP SDK*) that allows integrating the video management system with third-party applications, for example access control and video analytics.

2. *Integration Types and Functionalities*: Integration of third-party applications and plug-ins shall be possible in three different ways:

a. Integration through network protocols shall allow for the possibility to choose coding platform. Protocol integration shall make it possible to:

1) Retrieve, save, and change the configuration of the VMS through a SOAP or RESTful API.

2) Retrieve live or recorded video, audio, and metadata.

3) Send control commands and events to the VMS.

4) Receive VMS status information, for example if a camera is down or a server is running out of space.

5) Implement protocols on Windows, Java® and Linux® systems.

b. Integration through the .NET libraries which shall allow for using software components to integrate with the VMS. .NET integration shall make it possible to:

1) Retrieve, save, and change the configuration of the VMS.

2) Retrieve live and recorded audio and metadata.

3) Display live and recorded video with optional overlay of graphics.

4) Issue control commands to the VMS or related device, for example a camera with PTZ and outputs.

5) Send and receive events to the VMS.

c. Integration through a plug-in embedded directly into the VMS environment that shall run as part of the VMS and client applications. Plug-in integration shall make it possible to:

1) Be integrated with the event server, enabling the event server to use plug-in functionality. This shall allow event-based functionality to be executed without the need for an open user interface.

2) Be integrated with XProtect Smart Client, enabling the application to use plug-in functionality.

3) Be integrated with XProtect Management Client, enabling the application to use plug-in functionality.

4) Plug-ins shall be able to run across all products and versions of the VMS.

5) Plug-ins shall be able to listen for events from other plug-ins.

6) It shall be possible to activate licenses for third party plug-ins in XProtect Management Client.

d. Integration with Intelligent Video Analytics - through a cloud native containerized microservice-based application - shall make it possible to:

1) Deploy video analytics applications on the NVIDIA EGX platform.

2) Register video analytics applications with the VMS through a GraphQL API.

3) Discover available cameras, microphones, and media streams managed by the VMS through a GraphQL API.

4) Access media streams from video analytics applications using standard protocols, such as RTSP and gRPC.

5) Allow for events, metadata and media streams to be sent back into the VMS from video analytics applications using Kafka, gRPC, or a RESTful API.

3. *Integration Capabilities*: Third party applications shall be able to integrate with the VMS to access a variety of functionalities:

a. Video, Audio, and Metadata Functionality:

1) Retrieve and play live and recorded video.

2) Retrieve and play live and recorded audio.

3) Retrieve and access live and recorded metadata.

4) Retrieve and display single images (JPEG).

5) Export video and audio in AVI, MKV and native database format.

6) Place overlay information on live and recorded video in component-based implementation and in plug-ins for XProtect Smart Client.

7) Create, find, and delete bookmarks.

b. Configuration:

1) Retrieve and change VMS configuration, including camera, user and alarm information.

2) Enable third party applications to save and retrieve their own configuration.

c. *Authentication and Authorization*. Logins and authorization of third-party plug-ins, applications and protocol integrations:

1) Manage user rights on plug-in functionality.

2) A framework for system access and security token handling.

d. Event and Alarms:

1) Trigger internal (system-related) and external (integrated) events and alarms.
2) A specific event can trigger start or stop recording.
3) Search for existing alarms and events.
4) Update and acknowledge alarms.

e. *Licensing*. Read licenses and add own plug-in license:
1) Licensing of third-party integrations
2) Integration with online registration

f. System status:
1) Receive all status messages from the VMS, including server disk, CPU usage, and triggered events.

g. *Control*. Trigger output, control PTZ, start/stop recordings:
1) Send PTZ commands to cameras.
2) Retrieve PTZ position from absolute PTZ cameras.
3) Send a start or stop recording event from a specific event.
4) Set bookmarks in recording.
5) Activate external output.
6) Control video wall application functionality.
7) Send camera to a video-sharing monitor.
8) Send commands to third party-developed plug-ins.
9) Playback time controller.
10) Support for displaying plug-in items on smart map in XProtect Smart Client.
11) Change XProtect Smart Client theme

h. *System and Audit logs*. Generate log entries and reads logs:
1) Write and read systems and audit logs.

4. Use cases:
a. Compatibility with XProtect Transact, which integrate video surveillance with automatic teller machines (ATM), point-of-sale (POS) and enterprise resource planning (ERP) systems for managing loss prevention and fraud.
b. Compatibility with XProtect LPR for automatic reading and tracking of vehicle license plates.
c. Event integration via a simple message-based socket communication interface enabling external applications to trigger events in the VMS.
d. Functionality for external applications to trigger user-defined events in the VMS.

O. Computer Equipment

1. *Computer Requirements:* Consult with VMS manufacturer to determine current computer requirements appropriate for system design, intended use and desired level of performance. Optimize server computer count, and server application distribution across servers, to account for likely system expansion. The following are minimum requirements.

    a. Computer Running XProtect VMS:

        1) *CPU:* Intel® Core™ i3 or better.

        2) *RAM:* 16 GB or more.

        3) *Network:* Ethernet 2 x 1 Gbit or better.

        4) *Graphics Adapter:* Onboard GFX, AGP or PCI-Express, minimum 1024×768, 16-bit color or better.

        5) *Hard Disk Space:* 50 GB free or more (depends on number of servers, devices, rules, and logging settings).

        6) Operating System:

            a) For Individual Servers:

            b) Microsoft Windows 8.1 Pro (64 bit).

            c) Microsoft Windows 8.1 Enterprise (64 bit).

            d) Microsoft Windows 10 Pro (64 bit).

            e) Microsoft Windows 10 Enterprise (64 bit).

            f) Microsoft Windows 10 Enterprise LTSB (Long-Term Servicing Branch) 2016 (version 1607 or later).

            g) Microsoft Windows 10 IoT Enterprise, version 1803 or later (64 bit), IoT Core.

            h) Microsoft Windows Server 2012 (64 bit): Standard and Datacenter.

            i) Microsoft Windows Server 2012 R2 (64 bit): Standard and Datacenter.

            j) Microsoft Windows Server 2016 (64 bit): Essentials, Standard and Datacenter.

            k) Microsoft Windows Server 2019 (64 bit): Essentials, Standard or Datacenter.

            l) To Run Clustering/Failover Management Server:

            m) Microsoft Windows Server 2012/2012 R2 (64 bit) Standard or Datacenter.

            n) Microsoft Windows Server 2016 (64 bit) Essentials, Standard or Datacenter.

            o) Microsoft Windows Server 2019 (64 bit) Essentials, Standard or Datacenter.

        7) Software:

a) Microsoft .NET 4.7.2 Framework.

b) Microsoft .NET Core 3.1.13.

c) DirextX 11 or newer.

P. Licensing

1. *License Activation:* VMS shall offer easy-to-use automatic or manual online activation via the Internet and alternatively, offline activation via email and web for closed surveillance networks.
2. Server Base License:
   a. Require one mandatory XProtect Corporate server base license for installing the product.
   b. Server base license shall permit the following deployments within the legal entity purchasing the base license:
      1) Unrestricted number of Management Server services.
      2) Unrestricted number of Recording Server services.
      3) Unrestricted number of XProtect Smart Client, XProtect Web Client and XProtect Mobile client applications.
3. XProtect Smart Wall License:
   a. XProtect Smart Wall license shall permit connection of an unrestricted number of XProtect Smart Wall instances (including physical displays) and camera feeds.
4. Hardware Device License:
   a. Require one license per hardware IP address to connect:
      1) Cameras.
      2) Audio devices.
      3) Video encoders.
      4) Other devices.
   b. Support an unlimited number of hardware device licenses.
5. Licensing of Milestone Interconnect:
   a. Require one Milestone Interconnect device license per camera in an interconnected site that is enabled in the central XProtect Corporate system.
   b. Interconnect license shall be tied to the parent XProtect Corporate system showing the interconnected devices.
6. Licensing of Milestone Federated Architecture:
   a. The use of Milestone Federated Architecture is free and not subject to licensing. This implies that unrestricted sites and licensed cameras can be included in the federated hierarchy, without the need for additional or special licenses.
7. *License Overview Information:* License overview shall include add-on products.

8. *License Administration:* Provide expanded license information for multi-site installations where both the total used licenses for the common base license is presented along with the license use in the specific site.
    a. *Changes Without Activation:* A “Changes without activation” function shall allow additions and replacements of limited number of devices without requiring license device activation or reactivation.

Q. Video Management Data Storage Server
1. EIA 19” Rack Mount chassis, including all necessary mounting rails and hardware to mount in DIN (square hole) 4 post racks as provided under the work of Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures.
2. Each server not less than 2RU high.
3. The server shall have the minimum capacities as required by the VMS manufacturer including:
    a. CPU's: As required by the VMS Manufacturer.
    b. RAM: As required by the VMS Manufacturer.
    c. Operating System: As required by the VMS Manufacturer.
    d. USB or PS/2 style mouse port
    e. USB or PS/2 style keyboard port
    f. Dual 10/100/Gigabit/10Gigabit Ethernet Adapters
    g. Display Adapter (at least 1024 x 768 resolution @ 65,536 colors)
    h. If server cannot boot from iSCSI Raid Array, provide a boot disk hard drive, at least 1T SATA or SAS.
4. Quantity of servers: As required and recommended by the VMS manufacturer for the quantity equal to 1.3 times the number of cameras provided under the work of this Project.
5. Features/Functions/Performance - iSCSI Raid Arrays
    1) Total Capacity: As required to capture full-motion video at highest resolution of specified cameras stored without overwriting for at least 30 days continuous operation, assuming:
        1) 1.3 times the camera count initially provided with the Project.
        2) 3.5 megapixel recording resolution per camera or greater as required to match supplied cameras.
        3) H.264 compression
        4) 40% activity (motion present 40% of period)
            a) 15 frame per second motion recording
        5) Minimum RAID Architecture:
            a) As required by the VMS Manufacturer.
        6) Minimum Construction and Performance

a) As required by the VMS Manufacturer.

7) Rack mountable, EIA 19", including all necessary mounting rails and hardware to mount in square hole) 4 post racks with DIN (square) openings

8) Not larger than 6 RU.

R. Manufacturers, VMS System:

1. Milestone Systems, Inc XProtect Corporate (District Standard, No Substitution)

S. Manufacturers, Servers

1. As pre-qualified by the VMS Manufacturer.
2. BCDVIDEO
3. HP
4. Dell
5. Or equal.

T. Manufacturers, iSCSI Array: Quantity - As required to meet storage requirement.

1. As pre-qualified by the VMS Manufacturer.
2. NetApp Inc.
3. Isilon Systems
4. Dell
5. HP
6. pivot
7. Or equal.

U. Manufacturers, Hard Drives for iSCSI Array

1. Seagate
2. Western Digital
3. Or equal.

V. Rack Mount Monitor, Keyboard and 19” Display

1. Drawing Reference: 19RMMKVMK
2. Minimum Features, Functions, Performance, Construction
    a. Combines an 8-port KVM switch, 19” LCD screen, full keyboard and touchpad in a 1U rack-mountable drawer assembly.
    b. Mounts into 19”-wide rack, 26”-38” deep.
    c. Control up to 8 servers from a single, easily accessible console.
    d. Includes eight cables that support computers with either PS/2 or USB connections
    e. Flip-up/fold-down screen keeps the console from blocking access to rack equipment when not in use:

f. 19” monitor supports video resolutions up to 1280 x 1024

g. DDC emulation allows optimal output to the LCD

h. Multi-Level Password Security

i. Enhances security by limiting access to an administrator and up to 4 local users

j. Two-level log-out allows for manual log-out or automatic log-out after a user-defined period of time has passed.

3. Manufacturers:

a. Tripplite B020-U08-19-K

b. APC

c. Or equal.

2.5 CAMERAS AND RELATED

A. IP Surveillance Indoor and Outdoor Dome Camera, 5MP Dome network camera:

1. Drawing References:

a. Interior Cameras, Circle with 1 in center and one arrowhead, subscript CI

b. Exterior Cameras, Circle with 1 in center and one arrowhead, subscript CE

2. The dome network camera shall meet or exceed the following performance specifications:

a. Image sensor 1/2.7” progressive scan RGB CMOS

b. Lens
   1) Varifocal, 3–8 mm, F1.3
   2) Horizontal field of view: 104°–40°
   3) Vertical field of view: 74°–29°
   4) Remote zoom and focus, P-Iris control, IR corrected

c. Day and night Automatically removable infrared-cut filter

d. Minimum Illumination
   1) With Forensic WDR and Lightfinder 2.0:
      a) Color: 0.13 lux at 50 IRE, F1.3
      b) B/W: 0 lux at 50 IRE, F1.3

e. Shutter speed 1/33500 s to 1/5 s

f. Camera angle adjustment Pan ±180°, tilt ±75°, rotation ±175°

g. Video Compression
   1) H.264 (MPEG-4 Part 10/AVC) Baseline, Main and High Profiles
   2) H.265 (MPEG-H Part 2/HEVC) Main Profile
   3) Motion JPEG

h. Resolution 2592x1944 to 160x90

i. Frame rate 25/30 fps with power line frequency 50/60 Hz

j. Video streaming

1) Multiple, individually configurable streams in H.264, H.265, and
2) Motion JPEG
3) Axis Zipstream technology for H.264 and H.265
4) Controllable frame rate and bandwidth
5) VBR/ABR/MBR H.264/H.265

k. Multi-view Streaming
1) Up to 2 individually cropped out view areas in full frame rate

l. Image settings
1) Compression, color saturation, brightness, sharpness, contrast, local contrast, white balance, day/night threshold, tone mapping, exposure control (including automatic gain control), motion-adaptive exposure, exposure zones, defogging, Forensic WDR: up to 120 dB depending on scene, barrel distortion correction, fine tuning of low-light behavior, dynamic text and image overlay, privacy masks, mirroring, rotation: 0°, 90°, 180°,270°, including Corridor Format

m. Pan/Tilt/Zoom Digital PTZ, preset positions

n. Audio Streaming Full duplex

o. Audio Encoding
1) 24bit LPCM, AAC-LC 8/16/32/44.1/48 kHz, G.711 PCM 8 kHz, G.726 ADPCM 8 kHz, Opus 8/16/48 kHz
2) Configurable bit rate

p. Audio Input/Output
1) External microphone input, line input, digital input with ring power, line output, automatic gain control
2) Two-way audio connectivity via optional AXIS T61 Audio and I/O Interfaces with portcast technology

q. Security
1) Password protection, IP address filtering, HTTPSa encryption, IEEE 802.1X (EAP-TLS)a network access control, digest authentication, user access log, centralized certificate management, brute force delay protection, signed firmware, secure boot, Axis Edge Vault with Axis device ID

r. Supported Protocols
1) IPv4, IPv6 USGv6, HTTP, HTTP/2, HTTPS, SSL/TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP, Bonjour, UPnP®, SNMP v1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, SRTP, TCP, UDP, IGMP, RTCP, ICMP, DHCPv4/v6, ARP, SOCKS, SSH, SIP, LLDP, MQTT v3.1.1, Syslog

s. Application Programming Interface
1) Open API for software integration, including VAPIX® and AXIS Camera Application Platform; specifications at axis.com
2) AXIS Video Hosting System (AVHS) with One-Click Connection
3) ONVIF® Profile G, ONVIF® Profile S, and ONVIF® Profile T, specification at onvif.org
4) Support for Session Initiation Protocol (SIP) for integration with Voice over IP (VoIP) systems, peer to peer or integrated with SIP/PBX

t. Casing
   1) IP52-rated, IK10 impact-resistant polycarbonate casing with hard-coated dome and dehumidifying membrane
   2) Encapsulated electronics and captive screws
   3) Color: white NCS S 1002-B

u. Mounting
   1) Mounting bracket with holes for junction box (double-gang, single-gang, and 4" octagon) and for wall or ceiling mount ¼"-20 UNC tripod screw thread

v. Sustainability PVC free

w. Memory 1024 MB RAM, 512 MB Flash

x. Power
   1) Power over Ethernet (PoE) IEEE 802.3af/802.3at Type 1 Class 3
   2) Typical 6.5 W, max 10.5 W

y. Connectors
   1) RJ45 10BASE-T/100BASE-TX/1000BASE-T PoE
   2) I/O: 4–pin 2.5 mm (0.098 in) terminal block for 1 supervised digital input and 1 digital output (12 V DC output, max. load 25 mA)
   3) Audio: 4-pin 2.5 mm (0.098 in) terminal block for audio in and out
   4) Audio and I/O connectivity via AXIS T61 Audio and I/O Interfaces with portcast technology

z. IR illumination
   1) OptimizedIR with power-efficient, long-life 850 nm IR LEDs
   2) Range of reach 40 m (130 ft) or more depending on the scene

aa. Storage
   1) Support for microSD/microSDHC/microSDXC card
   2) Support for SD card encryption (AES-XTS-Plain64 256bit)
   3) Recording to network-attached storage (NAS)

bb. Operating Conditions
   1) 0 °C to 50 °C (32 °F to 122 °F)
   2) Humidity 10–85% RH (non-condensing)

3. Manufacturer:

   a. Interior Camera, Fixed
      1) Axis Communications P3247-LV (Design Basis)
         a) Provide the following mounts, as scheduled
            a. Axis T94K01D Pendant Kit including weather shield.
            b. Axis T91 Mounts

   b. Exterior Camera, Fixed
      1) Axis Communications P3247-LVE (Design Basis)
         a) Provide the following mounts, as scheduled
            a. Axis T94T01D Pendant Kit
            b. Axis T91 Mounts

B. IP Surveillance Interior/Exterior Dome Camera, Three Camera Sensors minimum, Fixed, 180° Combined Horizontal Angle:

1. Drawing References:
   a. Interior Cameras, Circle with 3 in center and three arrowheads, subscript CI
   b. Exterior Cameras, Circle with 3 in center and three arrowheads, subscript CE
2. The fixed dome multi-sensor network camera shall meet or exceed the following design specifications:
   a. Image sensor 4 x 5 MP 1/2.5” progressive scan RGB CMOS
   b. Lens
      1) Fixed 5.9 mm, F1.88
      2) Horizontal field of view: 180°
      3) Vertical field of view: 38°
   c. Day and night Automatically removable infrared-cut filter
   d. Minimum illumination
      1) With Forensic WDR and Lightfinder:
         a) Color: 0.16 lux, F2.0
         b) B/W: 0.06 lux, F2.0
   e. Shutter time 1/40000 to 1/25 s
   f. Camera angle adjustment
      1) Pan ± 135°
      2) Tilt 15° to 92°
      3) Roll ± 8°
   g. Video compression
      1) H.264 (MPEG-4 Part 10/AVC) Baseline, Main and High Profiles
      2) H.265 (MPEG-H Part 2/HEVC) Main Profile
      3) Motion JPEG
   h. Resolution 8192x1728 (14.2 MP) to 608x128
   i. Frame rate
      1) 14.2 MP @ 25/30 fps (50/60 Hz) WDR
   j. Video streaming
      1) One configurable stream in H.264, H.265 and Motion JPEG in full frame rate
      2) Multiple individually configurable streams in reduced frame rate
      3) Controllable frame rate and bandwidth
      4) VBR/ABR/MBR H.264/H.265
   k. Image settings
      1) Saturation, contrast, brightness, sharpness, Forensic WDR: up to120 dB depending on scene, white balance, day/night threshold, exposure mode, compression, dynamic text and image overlay, orientation aid, exposure control, noise reduction, fine tuning behavior at low light, polygon privacy masks
   l. Security
      1) Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X (EAP-TLS)a network access control, digest authentication, user

access log, centralized certificate management, brute force delay protection, signed firmware, protection of cryptographic keys with FIPS 140-2 certified TPM 2.0 module, Axis Edge Vault with Axis device ID

m. Supported protocols
   1) IPv4, IPv6 USGv6, ICMPv4/ICMPv6, HTTP, HTTP/2, HTTPS, TLS QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP, mDNS (Bonjour), UPnP®, SNMP v1/v2c/v3 (MIB-II), DNS/DNSv6, DDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCPv4/v6, ARP, SOCKS, SSH, LLDP, CDP, MQTT, Syslog, Link-Local address (ZeroConf)

n. Application Programming Interface
   1) Open API for software integration
   2) ONVIF® Profile S and ONVIF® Profile G, specification at onvif.org

o. Analytics Included
   1) video motion detection, active tampering alarm
   2) Supported
   3) perimeter defender, motion guard, fence guard, loitering guard
   4) Support for installation of third-party applications.

p. Event triggers Analytics, edge storage events, shock detection

q. Event actions
   1) Day/night mode, overlay text, video recording to edge storage, pre- and post-alarm video buffering, send SNMP trap
   2) File upload: FTP, SFTP, HTTP, HTTPS network share, email
   3) Notification: email, HTTP, HTTPS TCP

r. Data streaming Event data

s. Built-in installation aids Pixel counter, Leveling guide

t. Casing
   1) IP66-/IP67- and NEMA 4X-rated, IK10-rated impact-resistant casing with polycarbonate hard coated clear dome, aluminum base and dehumidifying membrane
   2) Color: white NCS S 1002-B
   3) For repainting instructions of skin cover or casing and impact on warranty, contact your distributor partner.

u. Mounting
   1) Mounting bracket with junction box holes (double-gang, single-gang, 4” square, and 4” octagon)
   2) ¾” (M25) conduit side entries

v. Sustainability PVC free

w. Memory 1024 MB RAM, 512 MB Flash

x. Power
   1) Power over Ethernet (PoE) IEEE 802.3at Type 2 Class 4
   2) Typical 12 W, max 22.5 W

y. Connectors
   1) Shielded RJ45 1000BASE-T

2) Terminal block for two configurable supervised inputs/digital outputs (12 V DC output, max load 50 mA), 3.5 mm analog/digital mic/line in

z. Storage
1) Support for microSD/microSDHC/microSDXC card
2) Support for SD card encryption
3) Support for recording to network-attached storage (NAS)

aa. Operating conditions
1) -40 °C to 50 °C (-40 °F to 122 °F)
2) Humidity 10–100% RH (condensing)
3) Maximum temperature according to NEMA TS 2 (2.2.7): 74 °C (165 °F)
4) Start-up temperature: -40 °C

3. Manufacturer:

a. Axis Communications Q3819-PVE (Design Basis)
1) Provide the following mounts, as required:
(1) Axis T94A01D Pendant Kit
(2) Axis T91B61 Wall Mount
(3) Axis T91B51 Ceiling Mount
(4) Axis T94A02F Ceiling Bracket
(5) Axis T91A64 Corner Bracket
(6) Axis T91B50 Telescopic Ceiling Mount

b. Or equal.

C. IP Surveillance Interior/Exterior Dome Camera, Four Camera Sensors, Fixed, 360° Combined Horizontal Angle:

1. Drawing References:

a. Interior Cameras, Circle with 4 in center and four arrowheads, subscript CI

b. Exterior Cameras, Circle with 4 in center and four arrowheads, subscript CE

2. The panoramic network camera shall meet or exceed the following design specifications:

a. Image sensor 4 x 1/2.8” progressive scan RGB CMOS

b. Lens
1) Varifocal, 3–6 mm, F1.8–2.6
2) 4x1080p capture mode:
3) Horizontal field of view: 96°–49°
4) Vertical field of view: 53°–27°
5) Diagonal field of view: 113°–55°
6) Motorized focus, motorized zoom

c. Day and night Automatically removable infrared-cut filter

d. Minimum illumination
1) Color: 0.20 lux at 50 IRE F1.8
2) B/W: 0.04 lux at 50 IRE F1.8, 0 lux with IR illumination on

e. Shutter speed 1/66500 s to 1/5 s with 50/60 Hz

f. Camera angle adjustment Pan ±90°, tilt 5–65°, rotation 5–95°, twist ±20°

g. System on chip (SoC)
   1) Model S5
   2) Memory 2048 MB RAM, 512 MB Flash

h. Video compression
   1) H.264 (MPEG-4 Part 10/AVC) Baseline, Main and High Profiles
   2) H.265 (MPEG-H Part 2)

i. Resolution 4 x 2560x1440 (4 x QHD 1440p) to 80x60

j. Frame rate Up to 25/30 fps (50/60 Hz)

k. Video streaming
   1) Multiple, individually configurable streams in H.264 and H.265
   2) Axis Zipstream technology in H.264 and H.265
   3) Controllable frame rate and bandwidth
   4) VBR/ABR/MBR H.264

l. Image settings
   1) Saturation, contrast, brightness, sharpness, WDR, white balance, exposure control, rotation: 0°, 90°, 180°, 270° including Corridor Format, dynamic text and image overlay, polygon privacy mask, compression

m. IP address One IP address for all channels

n. Security
   1) Password protection, IP address filtering, HTTPSa encryption, IEEE 802.1X (EAP-TLS)a network access control, digest authentication, user access log, centralized certificate management, brute force delay protection, signed firmware

o. Supported protocols
   1) IPv4, IPv6 USGv6, ICMPv4/ICMPv6, HTTP, HTTP/2, HTTPS, TLS, QoS Layer 3 DiffServ, FTP, CIFS/SMB, SMTP, mDNS (Bonjour), UPnPTM, SNMP v1/v2c/v3 (MIB-II), DNS/DNSv6, DDNS, NTP, RTSP, RTP, SRTP, SFTP, TCP, UDP, IGMPv1/v2/v3, RTCP, ICMP, DHCPv4/v6, ARP, SOCKS, SSH, LLDP, CDP, MQTT v3.1.1, Syslog, Link-Local address (ZeroConf)

p. Application Programming Interface
   1) Open API for software integration, including VAPIX® and
   2) AXIS Camera Application Platform; specifications at axis.com
   3) One-click cloud connection
   4) ONVIF® Profile G, ONVIF® Profile S and ONVIF® Profile T, specification at onvif.org

q. Analytics Included
   1) AXIS Motion Guard, AXIS Fence Guard, AXIS Loitering Guard
   2) AXIS Video Motion Detection, active tampering alarm
   3) Support for AXIS Camera Application Platform enabling installation of third-party applications, see axis.com/acap.

r. Event triggers

1) Detectors, hardware, input signal, storage, system, time, analytics, edge storage events
2) MQTT subscribe

s. Event actions
1) Day/night vision mode, overlay text, record video, send images, send notification, send SNMP trap, send video clip, status LED
2) File upload: FTP, HTTP, HTTPS, network share, SFTP and email
3) Notification: email, HTTP, HTTPS, TCP and SNMP trap
4) MQTT publish

t. Data streaming Event data

u. Built-in installation aids Pixel counter, focus assistant, remote focus, remote zoom

v. Casing
1) IP66-, IP67-, NEMA 4X-rated, IK09 impact-resistant, aluminium and plastic casing with polycarbonate hard-coated dome, sunshield (PC/ASA)
2) Color: white NCS S 1002-B

w. Mounting
1) Mounting bracket with junction box holes (double gang box, single gang box, 4” octagon junction box and 4” square junction box)
2) ½” (M20) conduit side entry
3) ¾” (M25) conduit adapter included

x. Sustainability PVC free

y. Power
1) Power over Ethernet (PoE) IEEE 802.3at Type 2 Class 4
2) IR illumination on: class 4, typical 16.3 W, max 25.5 W
3) IR illumination off: class 3, typical 10.7 W, max 25.5 W

z. Connectors
1) Shielded RJ45 10BASE-T/100BASE-TX/1000BASE-T PoE
2) Audio and I/O connectivity via AXIS T61 Audio and I/O Interfaces with portcast technology

aa. IR illumination
1) Four individually controllable IR with power-efficient, long-life 850 nm IR LEDs
2) Range of reach 15 m (49.2 ft) or more depending on the scene

bb. Storage
1) Support for microSD/microSDHC/microSDXC card
2) Dual SD cards
3) Support for SD card encryption
4) Support for recording to network-attached storage (NAS)

cc. Operating conditions
1) -30 °C to 50°C (-22 °F to 122 °F)
2) Humidity 10–100% RH (condensing)
3) Maximum temperature according to NEMA TS 2 (2.2.7): 74 °C (165 °F)

3. Manufacturer:
    a. Axis Communications P3719-PLE (Design Basis)
        1) Provide the following mounts, as required:
        2) Axis T94M02D Pendant Kit
        3) Axis T91D61 Wall Mount
        4) Axis T91B51, T91B63 Ceiling Mount
        5) Axis T91B50 Telescopic Ceiling Mount
    b. Or equal.

2.6 POWER SUPPLIES

A. Computer Grade Uninterruptible Power System, UL Listed

1. Drawing Reference: 2 KVA UPS
2. Features/Functions/Performance:
    a. Provide continuous, no-break power with sine wave output.
    b. Size to carry connected load.
    c. Provide Transient Over-Voltage (TOV) Surge Suppression; comply with ANSI/IEEE C62.41-1980, Category A and Category B.
    d. Provide complete isolation from Line.
    e. Provide output voltage regulation to ANSI C84.1 for computing equipment.
    f. SNMP manageable and status reporting to College's Management console. Provide Ethernet network interface on UPS.
    g. Provide output KVA, switch-mode power supply rated, not less than 150% of connected load indicated.
    h. Rack Mounted - at full height racks, provide rack mounted equipment.
3. Acceptable:
    a. APC Smart-UPS X 2000VA Rack/Tower LCD 100-127V
    b. Equal by Tripp Lite.
    c. Or Equal.

PART 3 - EXECUTION

3.1 PROGRAMMING AND INSTALLATION

A. Initial Systems Programming

1. Meet with College’s Representative to establish functional requirements for surveillance systems, including but not limited to the following:
    a. Camera Views
        1) Define in conjunction with the College’s representatives the minimum field of view to be provided at each fixed cameras. Contractor to review

the target for each camera at the Initial Systems Programming Meeting with the College's Representative and adjust the target view areas, and where required, the mounting location to provide the view currently required by the College's Representative. Where the mounting location requires adjustment, Contractor to coordinate related changes required with College's Representative.

2. Document and submit in accordance with the requirements of Section 28 05 00.

3. Provide initial systems programming in accordance with the preceding.

B. Installation

1. General

a. Conform to the manufacturer's recommendations and instructions regarding:
   1) camera mounting and adjustment.
   2) power and video cable sizing for length of indicated run.

2. Camera Installation

a. Locate the cameras in accordance with the plans and as required to provide the target images noted on the plans, except where modified through the pre-construction meeting described above.

b. Do not place cameras where they will be subject to ready access or tampering from persons in public access areas of the sites.
   1) Bring to the College's Representative attention through an RFI any proposed location that does not require a ladder or similar means of access from the public space.
   2) Obtain College's Representative's resolution of the RFI prior to proceeding with the installation.

c. Secure cameras to structure so that they cannot be readily removed, including with use tools or by force.
   1) Cameras are to be mounted to flush mounted backboxes at fed through rear of camera body, except where surface mounting is explicitly called for.
   2) Where surface mounting is indicated, use knock-outs on side of camera housing to connect to conduit. Install backbox containing required structured cabling biscuit box at remote location hidden from view and secure cover with tamperproof fasteners.
   3) Select fastening means appropriate to the mounting surface and its underlying framing system and fasten securely to the structure and not to lightweight surface materials. Removal of cameras following successful fastening shall require use of tamper fastener tooling or application of destructive force. College's Representative reserves the right to request remounting of any camera not found to meet this standard at no additional cost.

d. Where mounting to pipe mount indicated/or required by field conditions, select materials to maintain stability of camera image under environmental conditions associated with installation location, including wind load and potential for impact.

e. At exterior cameras, seal openings as directed by the manufacturer's instructions.

f. Apply manufacturer's recommended anti-graffiti coating to camera housings and domes.

g. Provide cameras with lensing as required to cover area of coverage indicated on the plans.

h. Adjust auto-iris systems at night to gain maximum depth of field under low light conditions.

i. Using a precision display portable video monitor and/or laptop, adjust each camera's angle and field of view as directed by the College's Representative.

3.2 SYSTEM STARTUP

A. The Contractor shall not apply power to the CCTV system until the following items have been completed:

1. CCTV system equipment items have been set up in accordance with manufacturer's instructions.

2. A visual inspection of the CCTV system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.

5. Power supplies to be connected to the CCTV system have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.3 SYSTEMS PERFORMANCE TESTING AND ADJUSTING PROCEDURES

A. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all site testing. The College's Representative will witness all performance verification and endurance testing. Written permission shall be obtained from the College's Representative before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the College's Representative at the conclusion of each phase of testing prior to College's Representative approval of the test.

B. Contractor's Field Testing.

1. The Contractor shall calibrate and test all equipment, verify system operation, place the integrated system in service, and test the integrated system. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142.

The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the College's Representative that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure. In addition, the Contractor shall make a master video tape recording to a USB stick showing typical day and night views of each camera in the system and shall deliver the USB stick with the report. Note any objects in the field of view that might produce highlights that could cause camera blinding. Note any objects in the field of view or anomalies in the terrain which may cause blind spots. Note if a camera cannot be aimed to cover the zone and exclude the rising or setting sun from the picture. Note night assessment capabilities and whether lights or vehicle headlights cause blooming or picture degradation. If any of the above conditions or other conditions exist that cause picture degradation or interfere with the camera field of view, the Contractor shall inform the College's Representative. The field testing shall as a minimum include:

a. Verification that the video transmission system and any signal or control cabling have been installed, tested, and approved as specified.

b. When the system includes remote control/monitoring stations or remote switch panels, verification that the remote devices are functional, communicate with the security center, and perform all functions as specified.

c. Verification that all cameras are aimed and focused properly. The Contractor shall conduct a walk test of the area covered by each camera to verify the field of view.

d. Verification that cameras facing the direction of rising or setting sun are aimed sufficiently below the horizon so that the camera does not view the sun directly.

e. When dome camera mounts are used in the system, verify that all preset positions are correct and that the dome also operates correctly in a manual control mode.

2. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the College's Representative that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

C. Performance Verification Test

1. The Contractor shall demonstrate that the completed CCTV system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The performance verification test, as specified, shall not be started until receipt by the Contractor of written permission from the College's Representative, based on the Contractor's written report. This shall include certification of successful completion of Contractor Field Testing as specified in paragraph "Contractor's Field Testing," and upon successful completion of training as specified. If the CCTV system is being installed in conjunction with an ESS, the CCTV performance verification test shall be run simultaneously with the ESS

performance verification test. The College's Representative may terminate testing at any time when the system fails to perform as specified. Upon successful completion of the performance verification test, the Contractor shall deliver test reports and other documentation as specified to the College's Representative prior to commencing the endurance test.

2. Testing

   a. Picture Monitors:
      1) Using indicated video test source, verify linearity and adjust as required.

   b. Camera Operation: Demonstrate that each camera:
      1) Produces images in conformance with specifications and as defined in the initial systems programming requirements.
      2) Includes date/time/camera number identification.

   c. Uninterrupted Power Systems: Disconnect normal power service. Demonstrate that the system remains in full operation for the specified time.

3.4 LABELING

A. Conform with the requirements of Section 27 05 53 – Identification for Communications Systems and for field devices, use the device label assigned per the requirements of Section 28 05 00 - Common Work Results for Electronic Safety and Security.

3.5 WARRANTY

A. Warranty

1. The VMS shall be warranted by the contractor for one (1) year from the date of Substantial Completion.

B. Maintenance and Service

1. The contractor shall provide all services required and equipment necessary to maintain the entire VMS in an operational state as specified for a period of one (1) year after formal written acceptance of the system, and shall provide all necessary material required for performing scheduled adjustments or other nonscheduled work.

C. Description of Work

1. The adjustment and repair of VMS includes computer equipment, contractor provided programming, software updates, signal transmission equipment, access control equipment, facility interfaces, and support equipment. Provide the manufacturers required adjustments, re-programming of deficient contractor programmed functions and other work as necessary.

D. Personnel

1. Service personnel shall be qualified to accomplish all work promptly and satisfactorily. Provide proof that Service personnel have successfully completed the enterprise level of both hardware and software training offered by the system

manufacturer. The College's Representative shall be advised in writing of the name of the designated service representative and of any change in personnel.

E. Inspections

1. The contractor shall perform two inspections at six (6) month intervals or more often if required by the manufacturers. This work shall be performed during regular working hours, Monday through Friday, excluding Federal holidays. These inspections shall include:
2. Visual checks and operational tests of the central processor, local processors, monitors, keyboards, system printers, peripheral equipment, VMS equipment, power supplies, and electrical and mechanical controls.
3. Clean system equipment, including interior and exterior surfaces.
4. Perform diagnostics on all equipment.
5. Check and calibrate each VMS device.
6. Run system software and correct diagnosed problems.
7. Resolve previous outstanding problems.

F. Warranty Service

1. The College’s Representative shall initiate service calls when the VMS is not functioning properly. Qualified personnel shall be available to provide service to the complete VMS.
2. The College's Representative shall be furnished with the telephone number where the contractor’s service supervisor can be reached at all times.
3. Service personnel shall be at the site within four (4) hours after receiving a request for service.
4. The VMS shall be restored to proper operating condition after one (1) calendar day.
5. Materials installed during warranty service to match or exceed specification of products originally installed for the specified function.

END OF SECTION

PART 1 - GENERAL

1.1 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. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:

1. 26 00 00 Electrical
2. 26 05 00 Common Work Results for Electrical
3. 21 00 00 Water-Based Fire-Suppression System
4. 23 00 00 Heating, Ventilating, and Air-Conditioning (HVAC)

C. The system and all associated operations shall be in accordance with the following:

1. Requirements of the following Building Code: CBC 2019 Edition
2. Requirements of the following Fire Code: CFC 2019 Edition
3. Requirements of the following Mechanical Code: CMC 2019 Edition
4. NFPA 72, National Fire Alarm Code, 2016 Edition
5. California Electrical Code, 2019 Edition
6. ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, 2016 Edition
7. ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities, 2009 Edition
8. Local Jurisdictional Adopted Codes and Standards
9. ADA Accessibility Guidelines

1.2 SUMMARY

A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.

C. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:

1. Fire alarm system detection and notification operations.
2. Control and monitoring of elevators, door hold-open devices, fire suppression systems, and other equipment as indicated in the drawings and specifications.

1.3 DEFINITIONS

A. ADA: Americans with Disabilities Act

B. AHJ: Authority Having Jurisdiction

C. ANSI: American National Standards Institute

D. ASME: American Society of Mechanical Engineers

E. FACU: Fire Alarm Control Unit

F. FM: Factory Mutual

G. IBC: International Building Code

H. ICC: International Code Council

I. IDC: Initiating Device Circuit

J. IEEE: Institute of Electrical and Electronic Engineers

K. IFC: International Fire Code

L. IMC: International Mechanical Code

M. IRI: Industrial Risk Insurers

N. LED: Light-emitting diode.

O. NAC: Notification Appliance Circuit

P. NFPA: National Fire Protection Association

Q. NICET: National Institute for Certification in Engineering Technologies.

R. RAC: Releasing Appliance Circuit

S. SLC: Signaling Line Circuit

T. UL: Underwriters Laboratories

U. ULC: Underwriters Laboratories, Canada

1.4 SYSTEM DESCRIPTION

A. General: Provide a complete, non-coded addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

B. Power Requirements

1. The control unit shall receive AC power via a dedicated fused disconnect circuit.

2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.

3. All circuits requiring system-operating power shall be 24 VDC nominal voltage and shall be individually fused at the control unit.

4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.
5. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.
7. The system shall support 100% of addressable initiating devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.
8. Loss of primary power shall sound a trouble signal at the FACU. FACU shall indicate when the system is operating on an alternate power supply.

C. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary.

1. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation.
2. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.
3. Panels shall be capable of full system operation during new site specific configuration download, master exec downloads, and slave exec downloads.
4. Remote panel site-specific software and executive firmware downloads shall be capable of being performed over proprietary fire alarm network communications.
5. Panels shall automatically store all program changes to the panel’s non-volatile memory each time a new program is downloaded. Panels shall be capable of storing the active site-specific configuration program and no less than 9 previous revisions in reserve. A compare utility program shall also be available to authorized users to compare any two of the saved programs. The compare utility shall provide a deviation report highlighting the changes between the two compared programs.
6. Panels shall provide electronic file storage with a means to retrieve a record copy of the site-specific software and up to 9 previous revisions. Sufficient file storage shall be provided for other related system documentation such as record drawings, record of completion, owner’s manuals, testing and maintenance records, etc.
7. The media used to store the record copy of site-specific software and other related system documentation shall be electrically supervised. If the media is removed a trouble shall be reported on the fire alarm control unit.

D. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

E. Recording of Events: The system shall be capable of recording all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout shall differentiate alarm signals from all other printed indications.

F. Wiring/Signal Transmission:

1. Transmission shall be hard-wired using separate individual circuits for each addressable signaling line circuit, dedicated to fire alarm service only.

2. System connections for initiating device circuits shall be Class B, signaling line circuits shall be Class B, and notification appliance circuits shall be Class B.

3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACU. Provide a distinctive indicating audible tone and alphanumeric annunciation.

G. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.

2. Noninterfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACU after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.

3. Transmission to an approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to an approved supervising station service provider, under another contract.

4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACU and the remote annunciator, indicating the type of device, the operational state of the device (i.e. alarm, trouble or supervisory) and shall display the custom label associated with the device.

5. Selective Alarm: A system alarm shall include:

a. Indication of alarm condition at the FACU and the annunciator(s).
b. Identification of the device that is the source of the alarm at the FACU and the annunciator(s).
c. Operation of audible and visible notification appliances until silenced at FACU.

d. Closing doors normally held open by magnetic door holders.
e. Shutting down supply and return fans building wide.
f. Closing smoke dampers on system building wide.
g. Transmission of signal to the supervising station.
h. Initiation of elevator Phase I functions (recall, shunt trip, illumination of indicator in cab, etc.) in accordance with ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, when specified detectors or sensors are activated, as appropriate.

6. Supervisory Operations: Upon activation of a supervisory device such as a tamper switch, the system shall operate as follows:

    a. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
    b. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
    c. Record the event in the FACU historical log.
    d. Transmission of supervisory signal to the supervising station.
    e. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible and visible alarm signals shall cease operation.

8. System Reset

    a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
    b. Should an alarm condition continue, the system will remain in an alarmed state.

9. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

10. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:

    a. The city circuit connection and any suppression release circuits shall be bypassed for the testing group.
    b. Control relay functions associated with one of the 8 testing groups shall be bypassed.
    c. The control unit shall indicate a trouble condition.
    d. The alarm activation of any initiating device in the testing group shall cause the audible notification appliances assigned only to that group

to sound a code to identify the device or zone.

e. The unit shall automatically reset itself after signaling is complete.

f. Any opening of an initiating device or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

1) Any device which is activated during the time that Walktest is enabled, but is not within the group under test shall immediately cause a normal alarm sequence to commence as if the system was not under any testing sequence.

11. Install Mode: The system shall provide the capability to group all non-commissioned points and devices into a single "Install Mode" trouble condition allowing an operator to clearly identify event activations from commissioned points and devices in occupied areas.

a. It shall be possible to individually remove points from Install Mode as required for phased system commissioning.

b. It shall be possible to retrieve an Install Mode report listing that includes a list of all points assigned to the Install Mode. Panels not having an install mode shall be reprogrammed to remove any non-commissioned points and devices.

12. Module Distribution:

a. The fire alarm control unit shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 7 (Class A) supervised serial communications channel (SLC):

1) Initiating Device Circuits
2) Notification Appliance Circuits
3) Auxiliary Control Circuits
4) Initiating Device Signaling Line Circuits
5) Notification Appliance Signaling Line Circuits
6) Power Supplies

H. Integrated Automation

1. Building Automation and Control Network (BACnet) Integration

a. The fire alarm control unit shall be capable of providing a one-way communications interface between the fire alarm control unit and an industry-standard Building Automation and Control Network (BACnet) using ASHRAE® BACnet® IP (internet protocol) compliant with ANSI/ASHRAE Standard 135.

b. The BACnet communications module shall be agency listed to UL Standard 864.

c. The fire alarm control unit shall be capable of communicating status changes of up to 1500 devices and system points to the building automation system. This shall include the capability to discretely identify and report the status of each notification appliance and initiating device.

d. Status of addressable initiating and notification devices shall be accomplished via multi-state BACnet objects, and each point shall

include detailed custom descriptions matching those provided in the fire alarm control panel site specific programming.

e. Programming of the BACnet interface shall be accomplished using the current version of the manufacturer's approved fire alarm panel programming software.

f. MS/TP Master and MS/TP Slave data link layer options communicating at baud rates up to 76,800 bps shall be supported.

g. The interface shall be capable of supporting ANSI X3.4, ISO 10656 (ICS-4), ISO 10656 (UCS-2), ISO 8859-1, or IBM/Microsoft DBCS character sets.

h. A standard RJ-45 Ethernet connection to the Building Automation System Ethernet network shall be provided at the fire alarm control unit as part of the contract.

i. Systems using relay interfaces shall not be accepted.

2. Refer to section: 25.00 Integrated Automation

I. Analog Smoke Sensors:

1. Monitoring: FACU shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.

2. Environmental Compensation: The FACU shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.

3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 selectable sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACU.

4. Sensitivity Testing Reports: The FACU shall provide sensor reports that meet NFPA 72 calibrated test method requirements.

a. Reports shall be capable of being printed for annual recording and logging of the calibration maintenance schedule.

b. Where required, reports shall be accessible remotely through:

1) A Fire Panel Internet Interface using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3. The Fire Panel Internet Interface shall be capable of automatically scheduling email reports to individual user accounts on a weekly, bi-weekly, or monthly schedule

5. The FACU shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to automatically indicate when a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate if a sensor is close to a trouble reporting condition and will be indicated on the FACU as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a sensor approaching dirty without creating a trouble in the system. If this indicator is ignored and the second level is reached, a "DIRTY SENSOR" condition shall be indicated at the

FACU and subsequently a system trouble is reported to the Supervising Station. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.

6. The FACU shall continuously perform an automatic self-test on each sensor that will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

7. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

8. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.

9. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

J. Fire Suppression Monitoring:

1. Water flow: Activation of a water flow switch shall initiate general alarm operations.

2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.

K. Audible Alarm Notification: By horns in areas as indicated on drawings.

L. Addressable Notification Appliances

1. Monitoring: The FACU shall monitor individual addressable notification appliances for status, condition, type of appliance, and configured appliance settings. A fault in any individual appliance shall automatically report a trouble condition on the FACU.

2. Individual Appliance Custom Label: Each addressable appliance shall have its own 40 character custom label to identify the location of the appliance and to aid in troubleshooting fault conditions.

3. Individual Appliance Information Display:

   a. The FACU shall be capable of calling up detailed information for each addressable appliance including the appliance location, status, condition, type of appliance, and configured appliance settings.
   b. Notification appliances that are not capable of communicating and reporting their individual location, status, condition, type of appliance, and configured appliance settings to the FACU shall not be accepted.

4. Programmable Appliance Settings:

a. The selectable operation of each addressable notification appliance shall be capable of being configured by the FACU without having to replace or remove the appliance from the wall or ceiling.
    1) Programmable appliance settings for applicable addressable notification appliances shall include:
        a) Operation:
            (1) General Evac
            (2) Alert
            (3) User Defined
        b) Style:
            (1) Indoor
            (2) UL Weatherproof
            (3) ULC Weatherproof
        c) Candela Selections:
            (1) Indoor: 15, 30, 75, 110, 135, or 185 cd (per UL1971)
            (2) UL Weatherproof: 15 or 75 cd (per UL1971), and 75 or 185 cd (per UL1638)
            (3) ULC Weatherproof: 20, 30 or 75 cd (per ULCS526)
        d) Horn Volume:
            (1) Hi
            (2) Low
        e) Horn Cadence:
            (1) Temporal 3
            (2) Temporal 4
            (3) March Time 20 bpm
            (4) March Time 60 bpm
            (5) March Time 120 bpm
            (6) Steady
        f) Horn Tone:
            (1) 520 HZ
            (2) Bell
            (3) Slow Whoop
            (4) Siren
            (5) Hi / Lo

b. Systems that require replacement or removal of the appliances from the wall or ceiling to change their applicable operation or settings shall not be accepted.

5. Programmable Notification Zones:

a. Changing the notification zone assigned to a notification appliance shall be configurable by the FACU and shall not require additional circuits or wiring.
b. Systems that require additional circuits and wiring to change the notification zone assigned to a notification appliance shall not be accepted.

6. Addressable Notification Appliance Automated Self-Test:

a. The fire alarm control unit shall be capable of performing an automated functional self-test of all self-test notification appliances and meet the requirements in NFPA 72, 14.2.8 Automated Testing and Table 14.4.3.2 testing requirements.
b. Test results for each self-test notification appliance shall be stored in non-volatile memory at the fire alarm control unit.
c. The fire alarm control unit shall be capable of running a functional automated test for all self-test notification appliances in a general alarm group or for all self-test appliances within a specific notification zone.
d. The duration required to complete the automated functional test for all self-test notification appliances shall be accomplished in 2 minutes or less.
e. The automated test results for all self-test notification appliances shall be available from the fire alarm control unit within 4 minutes from the start of the test.
f. If any notification appliance fails its automated functional self-test an audible and visual trouble signal shall be annunciated at the fire alarm control unit.
    1) The self-test trouble signal shall be a latching trouble signal which requires manual restoration to normal.

7. Addressable Notification Appliance Reports:
    a. The fire alarm control unit shall maintain configuration and test data for each self-test addressable notification appliance.
    b. The fire alarm control unit shall be capable of generating configuration, self-test, and deficiency reports, that can be viewed through the fire alarm control unit user interface or printed via the fire alarm control unit service port.
        1) At minimum, the configuration report shall include the following information applicable for each addressable notification appliance:
            a) Point ID
            b) Custom Label
            c) Device Type
            d) Candela Setting
        2) At minimum, the self-test report shall include the following information applicable for each self-test notification appliance:
            a) Point ID
            b) Custom Label
            c) Time and Date of last test
            d) Pass / Fail results of last visual test
            e) Pass / Fail results of last audible test
    c. The fire alarm control unit shall also be capable of providing a deficiency report that includes a list of all self-test notification appliances that have failed self-test.

8. Magnet test: When the control unit is in diagnostic mode, the appliances shall be capable of being tested with a magnet. The magnet diagnostics shall:

a. Pulse the appliance LED to indicate appliance address, and
b. briefly sound the individual horn to confirm the audible appliance operation, and
c. briefly flash the individual strobe to confirm visible appliance operation.

1.5 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

2. Wiring diagrams from manufacturer.

3. Shop drawings showing system details including location of FACU, all devices, circuiting and details of graphic annunciator.

4. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.

5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.

6. Operating instructions for FACU.

7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.

8. Product certification signed by a certified representative of the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.

9. Record of field tests of system.

B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions, if required, to make clarifications or revisions to obtain approval.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A factory authorized installer is to perform the work of this section.

B. Each and every item of the Fire Alarm System shall be listed under the appropriate category by a Nationally Recognized Testing Laboratory and shall bear the respective "NRTL" label.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of fire-alarm service.

2. Do not proceed with interruption of fire-alarm service without Architect's written permission.

1.8 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 MAINTENANCE SERVICE

A. Warranty Maintenance Service: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives

B. Basic Services: Routine maintenance visits on an “as needed” basis at times scheduled with the Owner. Respond to service calls within 24 hours of notification of system trouble either by customer visit or other customer contact as necessary. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

D. Maintenance Service Contract: No later than 60 days prior to the expiration of the warranty maintenance services, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. As an option with this proposal, deliver to the Owner a proposal to provide scheduled inspection and testing services for a one-year term. Owner will be under no obligation to accept maintenance service contract proposal or inspection and testing proposal.

1.10 EXTRA MATERIALS

A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:

1. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.
2. Notification Appliances: Furnish quantity equal to 10 percent of each type and number of units installed, but not less than one of each type.
3. Smoke Detectors or Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of each type and number of units installed but not less than one of each type.
4. Detector or Sensor Bases: Furnish quantity equal to 2 percent of each type and number of units installed but not less than one of each type.
5. Printer Ribbons: Furnish 6 spare printer ribbons when a printer is provided.

PRODUCTS

1.1 ACCEPTABLE EQUIPMENT AND SERVICE PROVIDERS

A. Manufacturers: The equipment and service described in this specification are those supplied and supported by Johnson Controls and represent the base bid for the equipment.

1. Subject to compliance with the requirements of this specification, provide products by Simplex, a Johnson Controls Company.

B. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.

C. Alternate products must be submitted to the Engineer two weeks prior to bid for approval. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

D. The equipment and service provider shall be a nationally recognized company specializing in fire alarm and detection systems. This provider shall employ factory trained and NICET Level II, Level III and Level IV certified technicians, and shall maintain a service organization within 50 miles of this project location. The equipment and service provider shall have a minimum of 10 years experience in the fire protective signaling systems industry.

1.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.

5. Duct smoke detectors.
6. Verified automatic alarm operation of smoke detectors.
7. Automatic sprinkler system water flow.
8. Heat detectors in elevator shaft and pit.
9. Fire-extinguishing system operation.
10. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions as required:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
8. Activate stairwell and elevator-shaft pressurization systems.
9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
10. Recall elevators to primary or alternate recall floors.
11. Activate emergency lighting control.
12. Activate emergency shutoffs for gas and fuel supplies.
13. Record events in the system memory.
14. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.

5. Abnormal AC voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer where provided.

1.3 FIRE ALARM CONTROL UNIT (FACU)

A. The following FACU hardware shall be provided:

1. Power Limited base panel with platinum cabinet and door, 120 VAC input power.
2. 3,000 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
3. 2000 points of annunciation where one (1) point of annunciation equals:
    a. 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
    b. 1 LED on panel or 1 switch on panel.
4. 9.5 Amp Power Supply minimum with temperature compensated, dual-rate battery charger capable of charging up to 110 Ah batteries without a separate external battery charger. Battery charger voltage and amperage values shall be accessible on the FACU LCD display. Optional cooling fan shall be available to increase base power supply from 9.5 to 12.7 Amps. Optional expansion and back-up power supplies shall be available.
5. One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
6. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
7. Three (3) circuit Class B Addressable Notification Appliance Signaling Line Circuits (SLCs) module.
    a. Each Addressable Notification Appliance SLC shall be rated at 3A and capable of supporting up to 127 Notification Appliances per channel.
    b. Wiring shall be 18 AWG to 12 AWG unshielded twisted pair wire. Systems that require shielded wire for Notification Appliances shall not be accepted.
    c. A constant voltage under both primary and secondary power conditions shall be maintained at the notification appliance field wiring terminal connections in the FACU to ensure the voltage drop on the circuit is consistent under both primary and secondary power conditions.
    d. For systems that do not provide a constant voltage source at the FACU notification appliance field wiring terminal connections, the fire alarm

contractor shall:

1) Provide separate point-to-point voltage drop calculations for all notification appliances under worst case secondary power specifications, and
2) Perform a complete functional test of all notification appliances under worst case secondary power conditions.

8. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory or other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
9. The FACU shall support up to (5) RS-232-C ports and one service port. All (5) RS-232 Ports shall be capable of two-way communications.
10. Remote Unit Interface: supervised Class B (Style 4) or Class X (Style 7) serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
11. Universal Communicator supporting POTS, Internet, and Cellular communications. Shall have multiple connectivity options and be configurable with a primary and secondary path. Paths can use any of the external connections; telephone line, cellular, or LAN Ethernet. Cellulat shall be minimum 3G with 2G fallback. Cellular antenna extension kits shall be available for poor reception areas. IP based transmission; cellular or Ethernet shall be based on ADEMCO Contact ID Alarm Communication Protocol.

B. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.

C. Alphanumeric Display and System Controls: Panel shall include an 854 character, expanded content multi-line QVGA LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

1. The system shall have the capability to provide expanded content, multi-line, operator interface displays. The expanded content multi-line displays shall be Quarter-VGA (QVGA) or larger and be capable of supporting a minimum of 854 standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system conditions. The QVGA operator interface shall provide operator prompts and six context sensitive soft-keys for intuitive operation.

a. Expanded content, multi-line operator interfaces shall be capable of providing the following functions:

1) Dual language operation with Instant-Switch language selection during runtime.
2) Activity display choices for:
a) First 8 Events.
b) First 5 Events and Most Recent Event (with first and

most recent event time and date stamps).
c) First Event and Most Recent Event (with first and most recent event time and date stamps).
d) Scrollable List Display displays a scrollable list of active points for the event category (alarm, priority 2, supervisory, or trouble) selected. The position in this list will be the last acknowledged point (not flashing) at the top followed by the next 7 unacknowledged points (flashing).
e) General Event Status (alarm, priority 2, supervisory, or trouble in system)
f) Site Plan

3) Equal or hierarchal priority assignment. In systems with two or more operator interfaces, each operator interface shall be programmable to allow multiple operator interfaces to have equal operation priority or to allow hierarchal priority control to be assigned to individual operator interfaces (locations).
4) Up to 50 custom point detail messages for providing additional point specific information in detailed point status screens.
5) Bitmap file import for operator interface display of site plan and background watermark images.

D. Distributed Module Operation: FACU shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Class B supervised serial communications channel (SLC):

1. Addressable Signaling Line Circuits
2. Initiating Device Circuits
3. Notification Appliance Circuits
4. Auxiliary Control Circuits
5. Graphic Annunciator LED/Switch Control Modules
    a. In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.

1.4 ADDRESSABLE INITIATING

A. ADDRESSABLE MANUAL PULL STATIONS

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
2. Description: Addressable single-action type, red LEXAN. Station shall mechanically latch upon operation and remain so until manually reset by

opening with a key common with the control units. Station shall be pull-lever type; be operable with one hand and shall not require tight grasping, pinching or twisting of the wrist; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

3. Provide with a front showing red LED showing that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the station LED shall be on steady.

B. ADDRESSABLE ANALOG SMOKE SENSORS

1. General Requirements for System Smoke Detectors:

a. Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
b. Factory Nameplate: Serial number and type identification.
c. Operating Voltage: 24 VDC, nominal and shall be two-wire type.
d. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
e. Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. Provide terminals in the fixed base for connection to building wiring. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit. Sensors shall include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACU. Sensor address shall be located in base to eliminate false addressing when replacing sensors. Integral Addressable Module shall be arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Each sensor base shall contain an integral visual-indicating LED that will flash to provide power-on status each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base.
f. Each sensor base shall contain a magnetically actuated test switch to provide for easy pre-certification alarm testing at the sensor location.
g. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
h. Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration,

sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit. Provide multiple levels of detection sensitivity for each sensor.

i. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACU.

j. The sensor's electronics shall be immune from nuisance alarms caused by EMI and RFI. Removal of the sensor head for cleaning shall not require the setting of addresses.

k. Bases: CO Sensor, relay output, sounder and isolator bases shall be supported alternatives to the standard base.

2. Addressable Sensor Bases

a. Standard base - Twist lock addressable base with address selection DIP switch accessible from front with sensor removed. Integral red LED for power-on (pulsing), or alarm or trouble (steady on). Locking anti-tamper design mounts on standard outlet box.

b. Sensor Base with remote device connection - All standard base features with wired connection for either a Remote LED alarm indicator or remote relay (relay is unsupervised and requires separate 24VDC)

c. Supervised Relay Bases - All standard base features and shall be available in either a 4-Wire Sensor Base to use with remote or locally mounted relay; requires separate 24 VDC, or as a 2-Wire Sensor Base to use with remote or locally mounted relay; no separate power required. Supervised relay operation shall be programmable and shall be manually operated from control panel.

d. Sensor base with built-in electronic alarm sounder - All standard base features and piezoelectric sounder shall provide high output (88 dBA) with low current requirements (20 mA). Sounder shall be synchronized via SLC communications or by the NAC if NAC powered, sounder shall operation shall be programmable and shall be manually operated from control panel.

C. ADDRESSABLE DUCT SMOKE SENSOR

1. Standard Addressable Duct Smoke Sensor Unit. Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Duct housing shall include relay or relay driver as required for fan shutdown.

a. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACU.

b. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable independent of the sensor head for activation by other alarm initiating devices within the fire alarm system. Relay shall be

mounted within 3 feet of HVAC control circuit.

c. Duct Housing shall provide a magnetic test area and Red sensor status LED and Duct Housing shall provide a relay control Yellow LED trouble indicator.

d. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

e. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.

f. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.

g. Each duct smoke sensor shall be provided with a Remote Test Station with an alarm LED and test switch.

h. Where indicated provide a NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

2. Addressable In-Duct Mounted Smoke Sensors. Photoelectric type, for applications with controlled dust and humidity providing HVAC duct smoke sensing where sampling tube designs are not appropriate. In-Duct housing shall include relay or relay driver as required for fan shutdown.

a. Shall accommodate duct airflow from 0 to 4000 ft/min (0 to 1220 m/min), and provide environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor by the FACU.

b. The In-Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable independent of the sensor head for activation by other alarm initiating devices within the fire alarm system. Relay shall be mounted within 3 feet of HVAC control circuit.

c. Standard models shall be for rectangular ducts from 6” (152 mm) square to 36” (914 mm) square with optional adapters available to allow use with round ducts of 6”, 8” (203 mm), 10” (254 mm) or 12” (305 mm) in diameter.

d. In-Duct Housing shall provide a magnetic test area and Red sensor status LED and In-Duct Housing shall provide a relay control Yellow LED trouble indicator.

e. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

f. Each duct smoke sensor shall be provided with a Remote Test Station with an alarm LED and test switch.

D. ADDRESSABLE HEAT SENSORS

1. General Requirements for Heat Detectors: Comply with UL 521.
2. Thermal Sensor Combination type: Fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; Actuated by either a selected fixed temperature or a rate of rise that exceeds a preset amount per minute unless otherwise indicated.
3. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag. Selectable rate compensated, fixed temperature sensing with or without rate-of-rise operation.
4. Mounting: Twist-lock base interchangeable with smoke-sensor heads.
5. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
6. Unless otherwise indicated, sensors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for temperature by fire-alarm control unit.
    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

E. ADDRESSABLE CIRCUIT INTERFACE MODULES

1. Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.
2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box or be cabinet mounted using appropriate mounting to allow quick replacement. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.
3. There shall be the following types of modules:
    a. Line Powered Monitor Circuit Interface Module
        1) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACU.
        2) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or

normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

b. Single Address Multi-Point Interface Modules

1) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.

2) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

3) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

c. Line Powered Control Circuit Interface Module

1) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

4. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACU. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

1.5 ADDRESSABLE NOTIFICATION

A. ADDRESSABLE ALARM NOTIFICATION APPLIANCES

1. Addressable Notification Appliances: The Contractor shall furnish and install Addressable Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).

a. Addressable Notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to

control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60pf/ft and a minimum 3 twists (turns) per foot.

b. All Notification Appliances shall operate as a completely independent device allowing for specific location alerting of both fire alarm and Mass Notification functions. Each visible device (both clear fire alarm and amber mass notification) shall be capable of operating on multiple notification zones or completely separate from all other notification devices, this allows “On the fly” program operation changes for Mass Notification alerting and fire alarm notification.

c. All Notification Appliances shall operate as a completely independent device allowing for appliances in handicap accessible rooms and other locations to operate on the same SLC and to activate individually based on an alarm condition in a room or as part of a general alarm condition where all appliances activate together.

d. Individual Notification Appliances shall be able to be grouped into zones (or operational groups) by central programming at the main fire alarm control unit.

e. Notification Appliances shall provide for “unobtrusive” testing. Each Notification Appliance shall be tested for audible and visible operation on an individual basis at the device or from the main fire alarm control unit, allowing for minimal invasive impact.

f. Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; addressable "T" Tapping shall be permitted. Up to 127 addresses can be supported on a single channel.

g. Each Addressable notification appliance shall contain an electronic module and a selectable address setting to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.

h. Each addressable notification appliance shall have electrical test point access without removing the device cover.

i. Both wall mount and ceiling mount devices shall be available along with weatherproof devices.

2. Addressable Horn: Addressable horn shall be listed to UL 464. Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. Horn appliances shall have a High/Low Setting, programmable by channel from the addressable controller or by appliance from the host FACU. The horn shall have a minimum sound pressure level of 83 or 89 dBA for steady) or of 79 or 85 dBA for coded operation. The horn device shall consist of three pieces: appliance, cover, and mounting plate. For ease of installation the mounting plate shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. When the appliance is

connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.

3. Addressable Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O device shall consist of a xenon flash tube and associated lens/reflector system, cover and mounting plate. For ease of installation the mounting plate shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The V/O appliance shall be provided with multiple minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135cd and 185cd. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance.
4. Addressable Audible/Visible: Addressable combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe device shall consist of a xenon flash tube and associated lens/reflector system, cover and mounting plate. For ease of installation audible/visible mounting plate shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. The strobe shall provide multiple minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135cd and 185cd. The Candela levels shall be settable from the fire alarm control unit or using a hardware selector on the appliance. The Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. The horn shall have a minimum sound pressure level of 83 or 89 dBA for steady or 79 or 85 dBA for coded operation. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The appliance shall be capable of two-wire synchronization with one of the following options:
    a. Synchronized Strobe with Horn on steady.
    b. Synchronized Strobe with Temporal Code Pattern on Horn.
    c. Synchronized Strobe with March Time cadence on Horn.
    d. Synchronized Strobe firing to NAC sync signal with Horn silenced.
5. Addressable Weatherproof Visible Only: Addressable weatherproof strobe shall be UL 1971 listed for indoor applications with strobe intensity selectable as 15 or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75) or 185 cd (WP185). The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The V/O device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof cover and weatherproof mounting box. The V/O appliance shall be provided with multiple minimum flash intensities of 15, 75, WP 75, or WP 185 candela. The Candela levels shall be settable from the fire alarm control unit or by using a hardware

selector on the appliance.

6. Addressable Weatherproof Audible/Visible: Addressable weatherproof horn/strobe shall be UL 464 and UL 1971 listed for indoor applications with strobe intensity selectable as 15 or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75) or 185 cd (WP185).. The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The A/V device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof cover and weatherproof mounting box. The strobe appliance shall be provided with multiple minimum flash intensities of 15, 75, WP 75, or WP 185 candela. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance. The Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. The horn shall have a minimum sound pressure level of 81 or 87 dBA for steady or 80 or 87 dBA for coded operation.

7. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:

    a. Report faults to the host FACU.
    b. On-board Yellow LED provides module status.
    c. After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

B. ADRESSABLE APPLIANCE SLC REPEATER

1. Addressable Repeater shall supervise channel (SLC) wiring and communicate with and control addressable notification appliances. The Repeater shall be a stand-alone panel capable of powering one (1) NAC SLC. The channel (SLC) shall be rated for 3 amps and support up to 127 addresses. Power and communication for the notification appliances shall be provided on the same pair of wires. It shall be possible to program the High/Low setting of the audible (horn) appliances by channel from the addressable controller.

    a. The Repeater shall provide a constant voltage output to ensure NAC current and voltage do not vary whether the panel is operating on AC or battery. The output voltage during alarm conditions shall be 29 VRMS.
    b. Addressable SLC notification appliance circuits shall be Class B.
    c. For Class B circuits, the Repeater shall support up to 4 Class B branches directly at its output terminals for one SLC.
    d. The internal power supply and battery charger shall be capable of charging up two 12.7 Ah batteries internally mounted or 25Ah batteries mounted in an external cabinet.

e. The Repeater panel can be mounted close to the host fire alarm control unit or remotely.
f. The Repeater status shall be communicated to the host fire alarm control unit and locally indicated.
g. A 200mA auxiliary output shall be available
h. The Repeater shall be listed to UL 864

2. Accessories: The contractor shall furnish any necessary accessories.

1.6 REMOTE QVGA LCD ANNUNCIATOR

A. Provide a remote QVGA LCD Annunciator, where shown with the same "look and feel" as the FACU operator interface. The Remote QVGA LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys as the FACU.

B. The QVGA Annunciator shall have an expanded content, multi-line display capable of supporting a minimum of 854 standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system conditions. The QVGA Annunciator shall provide:

1. Operator prompts and six context sensitive soft-keys for intuitive operation.
2. Seven (7) programmable control switches and associated LEDs.
3. Three (3) programmable general purpose LEDs.
4. Capability of supporting Dual Languages with Instant-Switchover between languages in runtime operation.
5. Support for both one-byte and two-byte characters.

C. Under normal conditions the QVGA LCD shall display a "SYSTEM IS NORMAL" message, the current time and date, and the quantity of abnormal status conditions for each event category (i.e., fire alarm, priority 2, supervisory, and trouble with status icons to indicate area status for highest priority active events.

D. The QVGA Annunciator shall be programmable for the following Activity display choices:

1. First 8 Events.
2. First 5 Events and Most Recent Event with First and Most Recent event time and date stamps.
3. First Event and Most Recent Event with First and Most Recent event time and date stamps.
4. Scrollable List Display displays a scrollable list of active points for the event category (alarm, priority 2, supervisory, or trouble) selected. The position in this list will be the last acknowledged point (not flashing) at the top followed by the next 7 unacknowledged points (flashing).
5. General Event Status (Alarm, Priority 2, Supervisory, or Trouble in system).
6. Site Plan with optional status icons to indicate area status for highest priority active events.

E. Should an abnormal condition be detected the appropriate LED (Alarm, Priority 2,

Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

F. The QVGA LCD shall display the following minimum information relative to the abnormal condition of a point in the system:

1. 40 character custom location label.
2. Type of device (e.g., smoke, pull station, waterflow).
3. Point status (e.g., alarm, trouble).

G. QVGA Annunciators shall be protected from unauthorized use via a locked door or equivalent means. In addition, in systems with two or more Annunciators, each Annunciator shall be programmable to allow multiple Annunciators to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciators (locations). Acknowledge, Silence and Reset operation shall be the same as the FACU.

1.7 DACT/IP/CELLULAR COMMUNICATOR TRANSMITTER

A. DACT/IP/Cellular communicator transmitter shall be listed to UL 864 for Central Station Service and be acceptable for use by the remote or central station.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for, or connected via TCP/IP or Cellular to a remote or central station. When contact is made with the remote or central station, signals shall be transmitted. If connecting by POTS and service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the remote or central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal. If service is by TCP/IP or Cellular and connection is lost, transmitter shall initiate the local trouble signal and a loss of connection shall be indicated at the central station.

C. Local functions of the DACT/IP/Cellular communicator transmitter shall include the following:

1. Configurable with a primary and secondary path.
2. Paths can use any of the external connections, telephone line, cellular, or LAN Ethernet connections.
3. 3G with 2G fall back cellular connection through the cellular module. Antenna extension kits for areas of poor connectivity.
4. Communications failure with the remote or central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.

3. Address or loss of power.
4. Low battery.
5. Abnormal test signal.
6. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Constant connection supervision and detects failures within 90 seconds for IP/Cellular connection.

G. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 5 minutes.

EXECUTION

2.1 INSTALLATION, GENERAL

A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

1. Factory trained and certified personnel.
2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
3. Personnel licensed or certified by state or local authority.

2.2 EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, Ethernet drops, and all other necessary material for a complete operating system.

B. Existing Fire Alarm Equipment shall be maintained fully operational until the new equipment has been tested and accepted.

C. Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material.

D. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

E. Device Location-Indicating Lights: Locate in the public space immediately adjacent to

the device they monitor.

F. Install manual station with operating handle 48 inches (1.22 m) above floor. Install wall mounted audible and visual notification appliances not less than 80 inches (2.03 m) above floor to bottom of lens and not greater than 96 inches (2.44 m) above floor to bottom of lens.

G. Mount outlet box for electric door holder to withstand 80 pounds pulling force.

H. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control units.

I. Automatic Detector Installation: Conform to NFPA 72.

J. Ethernet Drop: A standard RJ-45 Ethernet connection to the owner's Ethernet network shall be provided at each fire alarm control unit as part of the contract.

2.3 PREPARATION

A. Coordinate work of this Section with other affected work and construction schedule.

2.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated air-conditioning duct systems.
4. Alarm-initiating connection to elevator recall system and components.
5. Alarm-initiating connection to activate emergency lighting control.
6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
7. Supervisory connections at valve supervisory switches.
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Supervisory connections at elevator shunt trip breaker.
10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.

11. Supervisory connections at fire-pump engine control panel.

2.5 WIRING INSTALLATION

A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current edition of California Electrical Code.

B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

D. Ethernet Circuits:

1. Ethernet circuits shall be provided to the Fire Alarm Control Unit as shown on the plans.

2. Where a dedicated Fire Alarm Ethernet LAN is specified only Agency Listed Fire Alarm Ethernet hardware shall be installed.

3. The electrical contractor shall coordinate and ensure proper Ethernet connections occur at the fire alarm control unit prior to system turnover.

2.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

2.7 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

2.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.

2. National Institute for Certification in Engineering Technologies (NICET) fire

alarm certified.

3. International Municipal Signal Association (IMSA) fire alarm certified.

4. Certified by a state or local authority.

5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Inspection:

1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.

2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Acceptance Operational Tests:

1. Perform operational system tests to verify conformance with specifications:

a. Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified. Test Supervising Station Signal Transmitter. Coordinate testing with Supervising Station monitoring firm/entity.

b. Test each Notification Appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.

c. Test Fire Alarm Control Unit and Remote Annunciator.

2. Provide minimum 10 days notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation.

H. Final Test, Record of Completion, and Certificate of Occupancy:

1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

2.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance

personnel to adjust, operate, and maintain fire-alarm system.

2.10 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

2.11 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.

2. Schedule training with the Owner at least seven days in advance.

END OF SECTION 283111

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for the excavation, filling, recompacting, grading and disposal of excess material.

B. Excavated soil and land clearing debris to be 100% reused or recycled

C. Related Sections

1. Section 312324, “Trenching and Backfilling”

1.2 REFERENCED STANDARDS

A. ASTM International

1. ASTM C136-84a: Standard Method for Sieve Analysis of Fine and Coarse Aggregate

2. ASTM D1557: Laboratory Compaction Characteristics of Soil Using Modified Effort

3. ASTM D2922: Density of Soil and Soil-Aggregate in Place by Nuclear Methods

B. Caltrans – State of California Standard Specifications; latest edition

C. Geotechnical Investigation and Geologic Hazards Evaluation Laney College Library Learning Resource Center report prepared by Fugro dated February 28,2020

1.3 DEFINITIONS

A. Compaction

1. The degree of compaction is specified as percent compaction. Maximum densities refer to the maximum laboratory dry soil densities obtainable at optimum moisture content as determined by ASTM D1557.

2. Percent compaction (relative compaction) is the ratio of the measured field dry density to the laboratory maximum dry density.

B. Excavation Slope: Excavation slope shall be defined as an inclined surface formed by removing material from below existing grade.

1.4 SUBMITTALS

A. Product Data

1. Fill materials

2. Source of recycle facility

B. Test Reports

1. Gradation (ASTM C136)
2. Density-In-Place (ASTM D2922)

PART 2 – PRODUCTS

2.1 FILL MATERIALS

A. Class 2 Aggregate Base: Class 2 aggregate base for subsequent backfill and/or pavement base to be ¾ inches maximum Class 2 aggregate base conforming to Caltrans, Section 26.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Surplus Material: Unless otherwise specified, surplus excavated material shall be disposed of off-site in accordance with applicable ordinances and environment requirements at the expense of the Contractor.

B. Hauling

1. When hauling is down over highways or city streets, loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading.
2. Loads shall be watered after trimming to eliminate dust.

C. Subgrade: Unless directed otherwise on the drawings, soil subgrades in areas to receive engineered fill, slabs-on-grade, or pavements shall be scarified to a depth of at least 12 inches, moisture conditioned to approximately 3 percent above optimum water content and compacted per the requirements indicated in the plans.

D. Finish Grading

1. Finish surfaces shall be smooth, compacted and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.
2. Finish grades shall be as specified on the plans, except where a local change in elevation is required to match existing conditions, or to ensure proper drainage.
3. When the work is at an intermediate stage of completion, lines and grades shall be as specified within 0.1 foot or as necessary to provide adequate drainage.

3.2 FIELD QUALITY CONTROL

A. Fill material shall be placed in horizontal layers and compacted with power tampers, rollers, idlers, or vibratory equipment. Within the upper 5 feet of the finished ground surface, engineered fills shall be compacted to at least 90% relative compaction, as determined by ASTM D1557, or as approved by the Geotechnical Engineer. The

upper 6 inches of subgrade soils below pavements shall be compacted to 95% relative compaction or as indicated in the plans. Fill material shall be spread and compacted in lifts not exceeding 8-inches in uncompacted thickness.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications and procedure for the de-watering of excavations and disposal of water.

1.2 SUBMITTALS

A. Prior to installation of the de-watering system, submit shop drawings and design data indicating the following:

1. The proposed type of de-watering system
2. Arrangement, location and depths of system components
3. Complete description of equipment and instrumentation to be used, with installation, operation and maintenance procedures
4. Methods of disposal of pumped water
5. Necessary permits for water disposal

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Furnish all materials, tools, equipment, facilities, and services as required for providing the necessary de-watering work and facilities.

B. Provide backup equipment as necessary for the replacement and for unanticipated emergencies.

PART 3 - EXECUTION

3.1 DE-WATERING

A. Keep excavation reasonably free from water during construction.

B. Disposal of water shall not damage property or create a public nuisance.

C. Have on hand pump equipment and machinery in good working condition for emergencies and workmen available for its operation.

D. De-watering systems shall operate continuously until trenches are backfilled.

E. Groundwater shall be controlled to prevent softening of the bottom of excavations, or formation of “quick” conditions.

F. De-watering systems shall not remove natural soils.

G. Control surface runoff to prevent entry or collection of water excavations.

H. Release of groundwater shall be controlled to prevent disturbance of the natural foundation soils or compact fill.

I. There shall be no discharge of turbid or hazardous water on site.

J. Discharge or disposal of water shall be controlled to prevent erosion.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section Includes: Perform all excavation, shoring, potholing, dewatering, backfilling, compaction, pavement restoration, and grading necessary or required for the construction of the work as covered by these Specifications and indicated on the Drawings. The excavation shall include, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions that would interfere with the proper construction and completion of the required work.

B. Related Sections

1. Section 321123, “Aggregate Base”
2. Section 321216, “Asphaltic Concrete Paving”
3. Section 312319 “De-Watering”
4. Section 331000 “Water Utilities”
5. Section 333300 “Site Sanitary Sewerage System”
6. Section 334000 “Storm Drainage System”

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. State of California, Department of Transportation, Standard Specifications (Standard Specifications) July 1992.

C. State of California, Department of Transportation, Manual of Test (California Test).

1.3 SUBMITTALS

A. Submit the following:

1. Sheeting and Shoring Plan: Refer to Paragraph 1.5 below.
2. Potholing Report as described in Paragraph 3.2.
3. Samples and Test Results: Furnish, without additional cost to the Owner, such quantities of import materials as may be required by the Owner’s Representative for test purposes. Cooperate with the Owner’s Representative and furnish necessary facilities for sampling and testing of all materials and workmanship. Submit test results for import materials. Tests shall have been performed within 60 days of submission. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the Owner’s Representative, or used in the construction work until it has been inspected in the field by Inspector of Record.

1.4 QUALITY ASSURANCE

A. Source Quality Control: Test import materials proposed for use to demonstrate that the materials conform to the specified requirements. Tests shall be performed by an independent testing laboratory.

B. Field Quality Control:

1. The Owner will:

a. Review and test materials proposed for use.

b. Inspect placement and compaction of fill.

c. Test soils during placement of fill.

2. Contractor shall excavate holes for in-place soil sampling. Contractor shall be responsible for costs of additional inspection and re-resting resulting from non-compliance.

C. Testing Methods:

1. Durability Index: Manual of Test, State of California, Department of Transportation.
2. Specific Gravity: ASTM D854.
3. Laboratory Compaction: ASTM D1557, Method A or C.
4. In-Place Density: ASTM D2922.
5. Particle Size Analysis of Soils: ASTM D422.
6. Plastic Limit and Plasticity Index: ASTM D4318.
7. Soil Classification: ASTM D2487.
8. In-Place Moisture Content: ASTM D3017.

1.5 EXCAVATION AND TRENCHING

A. General Protection: Pursuant to Labor Code Sections 6705 and 6707, Contractor shall include in its base bid all costs incident to the provision of adequate sheeting, shoring, bracing or equivalent method for the protection of life and limb which shall conform to the applicable Federal and State Safety Orders.

B. Before beginning any excavation five (5) feet or more in depth, submit to the Owner's Representative a detailed plan showing the design of shoring, bracing, sloping or other provisions to be made for worker protection from the hazard of caving ground during excavations. Comply with the Standards established by the State of California Construction Safety Orders Title 24 of the California Administrative Code. If the detailed plan varies from such shoring system Standards it shall be prepared by a registered civil or structural engineer whose name and registration number shall be indicated on the Drawing. If a dispute arises as to whether the plan must be prepared

by a registered civil or structural engineer, the Owner's Representative's determination of the matter shall be final and conclusive. The cost of required engineering services shall be borne by the Contractor and shall be deemed to have been included in the amount of bid for the work as stated in the Agreement.

C. Neither the review nor approval of any plan showing design of shoring, bracing, sloping or other provisions for worker protection shall relieve Contractor from his obligations to comply with Construction Safety order Standards and Title 24 CAC for design and construction of such protective work, and Contractor shall indemnify Owner and Owner's Representative from any and all claims, liability, costs, actions and a cause of action arising out of or related to the failure of such protective system. The Contractor shall defend the Owner, its officers, employees and agents and the Owner's Representative in any litigation or proceeding brought with respect to the failure of such protective systems.

D. The Contractor shall comply with Section 382 of the Civil Code of the State of California relating to lateral, general and sub-adjacent supports wherever structures or improvements adjacent to an excavation may be damaged by such excavation.

E. Contractors must still comply with the State of California Construction Safety Orders, Article 6 – Excavations, Trenches, Earthwork. The requirements of Article 6 apply whether the excavation, trench or earthwork is less than 5', or 5' or more.

F. The Contractor shall select, install and maintain shoring, sheeting, bracing, and sloping as necessary to maintain safe excavations. The Contractor shall be responsible for ensuring such measures: (1) comply fully with 29 CFR Part 1926 OSHA Subpart P Excavations and Trenches requirements, (2) provide necessary support to the sides of excavations, (3) provide safe access to the Engineer's sampling and testing within the excavation, (4) provide safe access for backfill, compaction, and compaction testings, and (5) otherwise maintain excavations in a safe manner that shall not endanger property, life, health, or the project schedule. All earthwork shall be performed in strict accordance with applicable law, including local ordinances, applicable OSHA, CalOSHA, California Civil Code, and California Department of Industrial Safety requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Crushed Rock: ¾-inch maximum crushed virgin drain rock with a minimum durability rating of 58.

B. Import Backfill: Class 2, ¾-inch maximum aggregate base, Standard Specifications Section 26. Paragraphs 26-1.06 and 26-1.07 are not applicable.

Sieve Size	Percentage Passing
1-1/2 inch	100
1 inch	95 to 100
¾ inch	90 to 100

3/8 inch	15 to 85
No. 4	0 to 9

A. Geotextile Fabric: Mirafi FW300 or equivalent

B. Water: The water used shall be potable and free of objectionable quantities of silt, oil, organic matter, alkali, salts and other impurities. Water quality must be acceptable to the Owner's Representative.

C. Sandy Clay Loam: Provide sandy clay loam backfill in the top 18 inches in unpaved areas, 85% compaction.

1. Sandy Clay Loam Analysis: Submit a sample of sandy clay loam proposed for use to an accredited Soils Laboratory for "agricultural suitability" analysis report, including particle size, and evaluation of physical and chemical properties of soil and recommendations for adding amendments and fertilizers to the soil.

2. Upon approval of the Laboratory's report by the Owner's Representative, the recommendations in the report shall become a part of the Specifications and the quantities of soil amendment, fertilizer and other additives shall be adjusted to conform with the report at no additional cost to the Owner. Request Testing Laboratory to send one copy of test results directly to Owner's Representative.

3. Test Laboratory: Soil and Plant Laboratory, Inc. 352 Matthew Street (PO Box 153), Santa Clara, CA 95052, Tel. (408) 727-0330; or Root Zone Associates, PO Box 18911, San Jose, CA 95118, Tel. (408) 264-7024.

D. Controlled Density Fill (CDF):

1. Materials:

- Cement: ASTM C150, Type II or V. A maximum of twenty (20) lbs. of cement per cubic yard.
- Aggregate shall consist of fine aggregate, with our without coarse aggregate, with a maximum size of 1-inch, free of clay, organics, and other deleterious materials. Less than 10 percent by weight shall pass the No. 200 sieve, and materials passing the No. 40 sieve shall be nonplastic as determined in accordance with ASTM D4318.
- Water: Potable.
- Fly Ash: ASTM C618, Class F unless otherwise approved.

2. Mix Design:

- Performance Requirements: The CDF shall be proportioned to be a non-segregating, free flowing, self-consolidating, low shrink slurry.
- Mix Design Requirements: The Contractor and its supplier shall determine the materials and proportions used to meet the requirements of these Specifications. Design the mixes far enough ahead of placement to allow completion of trail mix testing and submittal of test results. The mix design(s) shall be prepared for the range of aggregate gradations that is expected to be used. The Contractor shall

make daily checks of the aggregate gradation and adjust the mix design as required to meet these Specifications.

- Material Strength Requirements: The unconfirmed compressive strength at 28 days shall be 100 psi as per ASTM D4832.

E. Concrete: Concrete encasement used for conduit backfill shall be rated 4000 psi at 28 days and shall have red dye additive. Submit mix design for approval.

F. Trench Plugs: Clayey soils as approved by the Geotechnical Engineer

PART 3 - EXECUTION

3.1 CONTROL OF WATER

A. All excavations shall be kept free from water and all construction shall be in the dry.

1. It should be presumed that the presence of groundwater will require dewatering operations. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering all excavations. At all times have on the project sufficient pumping equipment for immediate use, including standby pumps for use in case other pumps become inoperable.

2. Provide a sufficient number of pumps so as to hold the groundwater level at an elevation of not less than 1 foot below the lowest elevation of the pipe, duct or other material to be placed.

3. Dispose of water in such a manner as to cause no injury or nuisance to public or private property, or be a menace to the public health.

4. The dewatering operation shall be continuous, so that the excavated areas shall be kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.

5. Continue dewatering during backfilling operations such that the groundwater is at least 1 foot below the level of the compaction effort at all times. No compaction of saturated materials will be allowed.

6. Dewatering devices must be adequately filtered to prevent the removal of fines from the soil.

7. The Contractor shall be responsible for any damage to the foundations or any other parts of existing structures or of the new work caused by failure of any part of the Contractor's protective works. After temporary protective works are no longer needed for dewatering purposes, they shall be removed by the Contractor.

8. If pumping is required on a 24-hour basis, requiring engine drives, then engines shall be equipped in a manner to keep noise to a minimum.

9. Prevent disposal of sediments from the soils to adjacent lands or waterways by employing whatever methods are necessary, including settling basins and holding tanks for disposal off site

B. The Contractor shall be responsible for furnishing temporary drainage facilities to convey and dispose of surface water falling on or passing over the site.

3.2 EXISTING UTILITIES

A. General: The known existing buried utilities and pipelines except building connections are shown on the Drawings in their approximate location. The Contractor shall exercise care in avoiding damage to all utilities, as he will be held responsible for their repair if damaged. There is no guarantee that all utilities or obstructions are shown, or that locations indicated are accurate. Utilities are piping, conduits, wire, cable, ducts, manholes, pull boxes and the like.

B. Check on Locations (Potholing):

1. Contact the Owner and request them to locate their respective utilities prior to the start of "potholing" procedures. The Owner shall be given 7 days written notice prior to commencing potholing. The Owner has performed a limited investigation and has recorded those findings on the Contract Documents.

2. Clearly paint the location of all affected utility underground pipes, conduits and other utilities on the pavement or identify the location with suitable markers if not on pavement. In addition to the location of metallic pipes and conduits, non-metallic pipe, ducts and conduits shall also be similarly located using surface indicators and detection tape if present and shall then be similarly marked.

3. After the utility survey is completed, commence "potholing" to determine the actual location and elevation of all utilities where crossings, interferences, or connections to the new pipelines are shown on the Drawings, or indicated by surface signs. Prior to the preparation of piping shop drawings, or the excavating for any new pipelines or structures, the Contractor shall locate and uncover these existing utilities to a point 1-foot below the utility. Submit a report identifying each underground utility and its depth and station. Any variation in the actual elevations and the indicated elevations shall be brought to the Owner’s Representative's attention.

4. Excavations around underground electrical ducts and conduits shall be performed using extreme caution to prevent injury to workmen or damage to electrical ducts or conduits. Similar precautions shall be exercised around gas lines, telephone and television cables.

5. Excavations shall have surface dimensions of no more than 18" x 18". Air spades and vacuum excavators shall be used to limit the size of excavations and damage to adjacent facilities. Backfill after completing potholing. In existing streets, repave with project typical pavement section or match existing pavement section, whichever is greater.

C. Interferences:

1. If interferences occur at locations other than shown on the Drawings, the Contractor shall notify the Owner’s Representative, and a method for correcting said interferences shall be supplied by the Owner’s Representative. Payment for interferences that are not shown on the plans, nor which may be inferred from

surface indications, shall be in accordance with the provisions of the General Conditions. If the Contractor does not expose all required utilities prior to shop drawing preparation, he shall not be entitled to additional compensation for work necessary to avoid interferences, nor for repair to damaged utilities.

2. Any necessary relocations of utilities, whether shown on the Drawings or not, shall be coordinated with the Owner if instructed to do so in writing from the Owner's Representative.

D. Overhead Facilities: There may be existing overhead electric and telephone transmission lines on the site. These overhead utilities are not shown on the Drawings. Extreme caution shall be used when working in the vicinity of overhead utilities so as to prevent injury to workmen or damage to the utilities. The Contractor shall be required to comply with the applicable provisions of the California Construction Safety Orders when working anywhere on this project.

E. Existing gas, water, sewer and communications laterals are not specifically shown on the Drawings but do exist along the existing utility corridors. Protect all service laterals from damage due to construction operations. If any laterals are damaged, notify the Owner's Representative immediately. The cost of repair shall be borne by the Contractor.

3.3 GENERAL CONSTRUCTION REQUIREMENTS

A. Site Access: Access to the site will be over public and private roads. Exercise care in the use of such roads and repair at the Contractor's expense any damage thereto caused by Contractor's operations. Such repair shall be to the satisfaction of the Owner or agency having jurisdiction over the road. Take whatever means are necessary to prevent tracking of mud onto existing roads and keep roads free of debris. Contractor shall provide access plan for all phases of work for approval by Owner's Representative prior to trenching operations.

B. Traffic Regulation: Provide such flagmen, lighted barricades, flares, lights, warning signs, and safety devices as may be required for control of traffic adjacent to all areas of work. A minimum of one 12-foot-wide lane of traffic shall be kept open at all times.

C. Open Excavations: Provide chain link fence around all excavations left open during non-working hours in unpaved areas. In all paved areas (walkways and fire lanes) excavations left open during non-working hours shall be covered with steel plates.

D. Access: Free access must be maintained to all fire hydrants, water valves and meters, and driveways.

E. Open Trench Limitations: The Owner's Representative shall have the authority to limit the amount of trench to be opened or left open at any one time. In roads, excavation and pipe laying shall be coordinated to the end that a minimum of interference with public traffic will result. Trenches in streets and pathways shall be covered with trench plates at the end of each day. An open trench in existing streets shall be defined as any trench that has not been completely backfilled, satisfactorily compacted, and capped with the permanent pavement.

F. Demolition of Pavement: Where trenching or excavation occurs in paved areas, the pavement shall be scored and broken ahead of the trenching or excavation operation. The extent of paving

removed shall be limited to the minimum necessary for the excavation. The final trench repair shall have sawcut edges.

G. Dust Control: Take proper and efficient steps to control dust.

3.4 TRENCH EXCAVATION

A. There is no room on site for storing excavated material. All excavated material shall be disposed of off campus. All backfill material shall be imported.

B. Excavation to the extent shown on the drawings and under the drip line of trees shall be hand excavated to a level below the root zone of the trees – NO EXCEPTIONS.

C. Excavation for pipe and duct shall be in open cut. The trench shall be as wide as necessary for sheeting and bracing and the proper performance of the work up to the maximum width permitted by the typical cross-sections shown on the Drawings. The sides of the trenches shall be vertical in existing streets. The bottom of the trench shall be constructed to the grades and shapes indicated on the Drawings. Should the Contractor desire to use other equivalent methods, he shall submit his method of construction to the Owner's Representative for favorable review prior to its use.

D. Take care not to overexcavate. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints, and as hereinafter specified. Dig bell holes and depressions for joints after the trench bottom has been graded, and, in order that the pipe rest on the bedding for as nearly its full length as practicable, bell holes and depressions shall be only of such length, depth and width as required for properly making the joint. Remove stones as necessary to avoid point bearing.

E. Backfill and compact overexcavations to 95% of its maximum dry density with Class II Aggregate Base material. Provide filter fabric (Mirafi, or equal) above, below, and on both sides of aggregate base as directed by the Owner's Representative. There shall be no additional payment to the Contractor for overexcavations not directed by the Owner's Representative. Remove unsatisfactory material encountered below the grades shown as directed by the Owner's Representative and replace as directed. Payment for removal and replacement of such unsatisfactory material directed by the Owner's Representative shall be made in accordance with the provisions of the General Conditions.

F. Grade trenches so that they are uniformly sloped between the pipe elevations shown on the Drawings. Comply with the minimum and maximum trench widths shown on the Drawings. Notify the Owner's Representative if the trench width exceeds the maximum allowable width for any reason.

G. For all piping or conduits to be placed in any excavated and backfilled area, such as at manholes or for building connections, the structural backfill shall be first compacted to a level at least 3 feet above the top of the piping or conduit elevation and then retrenched to pipe grade.

H. Provide ladders for access to the trench by construction and inspection personnel.

3.5 SAFETY BARRICADES AND LIGHTS

A. Where required for protection of workmen, public safety, or as required by State Laws, substantial barricades shall be provided for the areas where excavation, trenching, construction and demolition work are being performed. Safety Barricades shall not be used in lieu of required guardrails on temporary bridges crossing trenches, excavations or other openings. For protection of the *Visually Impaired*, safety barricades shall be joined together with 3" yellow *Caution* tape as follows:

1. Two strands of caution tape running continuous from barricade to barricade, one at the tops of the barricades and one at a height of from 4" to 12" above grade or mounting level.

2. In addition battery-operated warning lights shall be maintained on such barricades, whenever visibility is restricted, and at night.

3.6 BACKFILL AND COMPACTION

A. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings and compacted to the degree specified on the Drawings. Place bedding and backfill materials in horizontal lifts not to exceed 8 inches in thickness measured before compaction. The difference in level on either side of a pipe or duct shall not exceed 4 inches.

B. Backfill material shall not be placed over the pipe or duct until after it has been inspected by the Owner's Representative.

C. It shall be incumbent upon the Contractor to protect the pipe or duct from damage during the construction period. It shall be the Contractor's responsibility to repair broken or damaged pipe or duct at no extra cost to the Owner. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers and other machines that will not injure or disturb the pipe or duct. Carefully place backfill around and over the pipe or duct.

D. Do not allow construction traffic nor highway traffic over the pipe trench until the trench backfill has been brought back even with existing adjacent grade.

E. Add water to the backfill material or dry the material as necessary to obtain the optimum moisture content for the compaction shown on the Drawings or specified. If the Owner's Representative determines that the nature of the ground in which the trench lies precludes compaction of the backfill to the specified density, the backfill shall be compacted to the maximum practicable density. Employ such means as may be necessary to secure a uniform moisture content throughout the material of each layer being compacted. After the material has been moisture conditioned, compact it with compaction equipment approved by the Owner's Representative to achieve specified compaction. The Contractor shall be responsible for obtaining the densities specified. Should the Contractor fail, through negligence or otherwise, to compact to specified density, or to backfill and compact to surface grade, thus permitting saturation of the backfill material from rains or from any other source, the faulty material shall be removed and replaced with approved material which shall be compacted to the specified

density at optimum moisture content, and no additional payment will be made for doing such work or removal and replacement.

F. Compaction by flooding, ponding or jetting will not be permitted.

3.7 CONTROLLED DENSITY FILL (CDF)

A. Trench Backfill:

1. Contractor can choose to backfill trench with CDF in place of Class II Aggregate Base. (See trench sections on drawings.)

2. CDF shall be placed into the trench so that the CDF is placed evenly to prevent uneven loading of the pipe. CDF shall not be placed directly onto the pipe. The maximum depth of the first lift of CDF shall not allow the pipe to move or float. Subsequent lifts of CDF shall be placed so that that pipe does not shift or float. CDF placed in trenches with steep slopes shall be placed in lifts to prevent flotation of the pipe, and the Contractor shall install approved sand bags as needed to secure the pipe in place during placement of the CDF.

3. The maximum temperature of the CDF shall be 74°F at the time of placement. The minimum temperature of the CDF shall be 40°F at the time of placement. CDF shall be placed in lifts not exceeding 6 inches. Each lift shall be allowed to cure long enough to lose its fluid properties before placing the next lift.

3.8 SUPPORT OF EXCAVATIONS

A. Adequately support excavation for trenches and structures to meet all applicable requirements in the current rules, orders and regulations. Excavation shall be adequately shored, braced and sheeted so that the earth will not slide or settle and so that all existing structures and all new pipe and structures will be fully protected from damage. Keep vehicles, equipment and materials far enough from the excavation to prevent instability.

B. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from the high groundwater table and the nature of the soil excavated. Attention is directed to Section 832 of the Civil Code of the State of California relating to lateral and subjacent supports, and wherever structures or improvements adjacent to the excavation may be damaged by such excavation, the Contractor shall comply with this law.

C. The support for excavation shall remain in place until the pipeline, duct or structure has been completed. During the backfilling of the pipeline or structure, the shoring, sheeting and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement or flowing of the subsoils.

3.9 FINISH GRADING

A. Except where shown otherwise in the Drawings, restore the finish grade to the original contours and to the original drainage patterns. Grade surfaces to drain away from structures. The finished surfaces shall be smooth and compacted.

3.10 DISPOSAL OF EXCAVATED MATERIAL

A. Dispose of all excavated material offsite in a legal manner.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Slope protection, erosion control, and rip rap placement, and shall consist of all permanent and temporary erosion control features as indicated for the purpose of preventing on-site erosion and maintaining all sediments within the project boundaries and comply with the requirements of the District.

1.2 SCHEDULING

A. Apply erosion control features within five days after completion of all other work in each area.

B. Apply erosion control features as necessary for wet weather conditions and as directed by District.

1.3 REPLACEMENT

A. Any area in excess of 100 square feet of dead or damaged erosion control material shall be replaced.

B. The replaced erosion control shall be of the same formulation and quality as the original.

PART 2 - PRODUCTS

2.1 EROSION CONTROL BLANKETS

A. Erosion control blankets shall be North American Green single net straw blanket, Western Excelsior excel SR-1, or equivalent.

2.2 FIBER ROLLS

A. Fiber rolls shall be netted tubes, at least 12 inches in diameter, filled with straw or equivalent biodegradable product. Installation shall be in accordance with "Erosion and Sediment Control Field Manual" (latest edition) by the California Regional Water Quality Control Board, San Francisco Bay Region.

2.3 SILT FENCE

A. Silt fence shall be per "Erosion and Sediment Control Field Manual" (latest edition) by the California Regional Water Quality Control Board, San Francisco Bay Region.

2.4 RIP RAP

A. Rip rap shall conform to Class 1, Type B Drain Rock conforming to Caltrans Section 68, unless otherwise noted.

B. Geotextile fabric shall be Mirafi 600X Filter Fabric or equivalent.

C. Placing

1. The Contractor shall place a geotextile stabilization fabric over the areas to receive rip rap. Fabric edges shall overlap at least one and one-half feet.

2. Rip rap shall be placed to the line, grade and depth shown on the plans. Rip rap shall be placed in such a fashion (Caltrans Method A Placement) as not to puncture or tear the underlying fabric. The contractor shall replace torn sections of fabric with a piece of the same fabric. Fabric overlap in these areas shall be at least three feet.

3. Rip rap shall be placed in such a manner that the material does not segregate itself into areas of larger and smaller rip rap.

2.5 EQUIPMENT, MATERIALS, AND FACILITIES

A. Furnish all materials, tools, equipment, facilities, and services as required for providing the necessary erosion controls.

PART 3 - EXECUTION

3.1 APPLICATION

A. Erosion Control Blankets: Shall be installed and staked according to manufacturer's recommendations for slopes.

B. Silt Fences: Install to intercept and detain sediment prior to entering storm drainage.

C. As erosion control measures near capacity for silt retention, the Contractor shall remove the silt materials. The Contractor shall remove the materials from the site or to an area that is designated by the Owner. The Contractor shall then reestablish the silt fences, fiber rolls, straw bales, or rip rap to its original state.

3.2 INSPECTION

A. Silt fences, fiber rolls, and rip rap shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately, to the satisfaction of the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Machine drilled shaft.

B. Concrete and reinforcement.

C. Shaft liner, if required.

1.2 RELATED REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcement: Requirements for concrete reinforcement.

B. Section 03 30 00 - Cast-In-Place Concrete: Requirements for concrete.

1.3 REFERENCE STANDARDS

A. ACI 336.1 - Specification for the Construction of Drilled Piers; 2001.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

D. ASTM A929/A929M - Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe; 2018.

1.4 SUBMITTALS

A. See Division 1 - Administrative Requirements, for submittal procedures.

B. Project Record Documents: Record actual locations of piers, pier diameter, and pier length. Accurately record the following:

1. Sizes, lengths, and locations of piers.

2. Sequence of placement.

3. Final base and top elevations.

4. Deviation from indicated locations.

C. Submit pier installer qualifications to the District's Representative for review and approval at least thirty (30) days prior to commencement of drilling.

D. Submit proposed support method to the District's Representative for review and approval at least thirty (30) days prior to commencement of drilling. Acceptable methods are full depth steel casing or drilling fluids.

E. Logs of concrete placement for each pier, documenting the theoretical volume of concrete required (cubic yards, to nearest cubic foot) versus the actual placed concrete volume for each pier.

1.5 QUALITY ASSURANCE

A. A. District's Quality Assurance Testing and Inspection: The District will employ a Geotechnical Engineer, to serve as the District's Representative, to inspect and test the work of this section. This does not alleviate the Contractor from providing quality control during this portion of the work. At the completion of this work the Geotechnical Engineer will be required to submit a written report stating that the Piers were properly constructed with acceptable materials and construction practices in accordance with the Contract Documents. The Geotechnical Engineer shall be permitted free and unrestricted access to the site as required for the performance of his duties.

B. The District's Representative (Geotechnical Engineer) will inspect pier shafts during drilling and during the installation of reinforcement, will test soil materials, will independently establish Pier depth, and will inspect completed piers for voids using non-destructive means via the inspection conduits and other methods.

C. Notice: Provide the District's Representative at least five (5) working days notice prior to start of each phase of earthwork operations

D. Contractor's Quality Control Testing and Inspection: Quality control requirements shall be the sole responsibility of the Contractor. The Contractor shall hire and pay for services of an independently operating Testing Agency, referred to herein as the Contractor's Testing Agency, to perform the tests needed to satisfy quality control requirements at no additional cost to the University. All test results shall be submitted to the District's Testing Agency for review. The Contractor shall submit the qualifications of the retained Testing Agency for approval. The Contractor's Testing Agency shall not be the same agency retained by the University for quality assurance tests and inspections.

E. Pre-Construction Conference: Before commencing pier work, conduct a conference at the project site with the District's Representative, and other concerned entities. Review pier construction procedures, the requirements for temporary shoring and dewatering, and work responsibilities including testing and inspection procedures. Notify participants at least three weeks prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

F. Materials and installed work may require testing and retesting at any time during progress of work. Allow free access to material stockpiles and facilities.

1.4 CONTRACTOR'S QUALITY CONTROL

A. Comply with latest edition of the following standards:

1. American Concrete Institute (ACI) "Reference Specification for the Construction of Drilled Piers" (ACI 336.1), and Commentary (ACI336.1R-98), and as herein specified.

2. Where provisions of above standard conflict with local building regulations, building regulations will govern, but only to establish minimum requirements.

B. Comply with requirements of local, state and Federal Regulatory Agencies, including, but not limited to:

1. State of California Construction Safety Orders (CAL/OSHA), latest edition.

C. Pier Installer Qualifications:

1. The Pier installer must have completed not less than five successful projects with similar soil conditions, shaft sizes, depth and volumes of work contained in this project in past five years.

D. Survey work:

1. Engage a surveyor, registered in the State of California, to perform surveys, layouts, and measurements for Pier work.

2. Conduct layout work for each pier to lines and levels required before excavation, and actual measurements of each pier's horizontal axial location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other data as required.

3. Record and maintain information pertinent to each Pier and cooperate with other testing and inspection personnel to provide data for required reports.

E. Provide design and type of steel casing to meet project requirements, or design of hole support system using drilling fluids, including the containment and filtering of the drilling fluids.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities by careful hand excavation before starting pier excavation operations.

1. If utilities are to remain in place, provide protection from damage during pier operations.

2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult District's Representative immediately for directions as to procedure.

3. Cooperate with District's Representative, and public or private utility companies in keeping their respective service and facilities in operation.

4. Repair damaged utilities to satisfaction of utility owner.

5. Do not interrupt existing utilities serving facilities occupied and used by the University or others, except when permitted in writing by the District's Representative and then only after acceptable temporary utility services have been provided.

C. Environmental Requirements:

1. When unfavorable weather conditions necessitate interrupting drilling of piers, work shall stop.

2. Provide adequate temporary drainage to prevent water accumulation in piers.

3. Pump Piers when directed by the District's Representative (Geotechnical Engineer).

D. Maintain and safe workplace and barricade open excavations and post with warning lights in accordance with Section 01 50 00 – Temporary Facilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Casing: Temporary casings of steel complying with ASTM A283/A283M, Grade C; ASTM A36/A36M; or ASTM A929/A929M; of sufficient strength to withstand handling and drilling stresses, concrete pressures, and surrounding earth and water pressures.

B. Concrete Materials and Mix: Specified in Section 03 30 00.

C. Reinforcement: Specified in Section 03 20 00; spiral wound.

D. PVC Pipe: Diameter as specified, Schedule 40 in accordance with ASTM D 2665, or approved equal.

PART 3 - EXECUTION

3.1 FABRICATION

A. Pier reinforcing cage shall be fabricated with extra diagonal reinforcement to maintain the integrity and alignment during the handling and placement of the cage. The cage shall be configured to allow for insertion of a tremie tube for concrete placement.

3.2 PREPARATION

A. Use placement method which will not cause damage to nearby structures.

B. Protect structures near the work from damage.

C. Prepare to place piers from existing site elevations.

D. Grade perimeter of pier and shaft area to prevent surface water from draining into soil borings. Provide temporary means and methods, as required, to maintain surface diversion until no longer needed, or as directed by the Architect.

3.3 EXAMINATION

A. Prior to commencement of drilling piers, become familiar with site conditions.

B. In the event unsatisfactory site conditions are found, immediately notify the District's Representative in writing, indicating the nature and extent of unsatisfactory conditions.

C. Protect adjacent affected structures from damage.

D. Drill and cast piers only in the physical presence of the District's Representative (Geotechnical Engineer).

1. Notify the District's Representative at least 48 hours prior to commencing work

3.4 PIER EXCAVATION

A. A. Excavate holes for piers, only after adjacent holes are filled with concrete and allowed to set for a minimum of 12 hours. No more than two holes may be drilled and open at any time.

B. Temporary Shaft Protection using Steel Casing:

1. The Contractor shall conduct investigations as needed to identify the requirements for casing. No adjustment to the contract amount will be made for casing that may be required.

2. Provide full-length watertight steel casings of sufficient thickness to withstand compressive and withdrawal stresses as required to maintain shaft walls without displacing.

3. Temporary casings shall be removed as concrete is placed.

C. Temporary Shaft Protection using Drilling Fluids: If drilling fluid (bentonite or polymer slurry) is to be used in lieu of steel casing, the contractor shall provide the details of such operation to the District's Representative for review and approval. Information shall contain drilling fluid to be used, methods for containing, collecting, filtering, clean-up and disposal of drilling fluids. Water may not be used as a drilling fluid.

D. Dispose of excavated material in accordance with provisions of Section 31 20 00 – Structural Earthwork.

3.5 INSTALLATION

A. Construct piers in accordance with ACI 336.1.

B. Drill vertical pier shafts to diameters and depths indicated. The depth, diameter, and plumbness/straightness of the drilled hole must be checked and verified after drilling is completed.C. Place steel casings immediately after drilling. Set firmly in place. If casing is to be temporary, install shaft liner with sufficient strength to withstand concrete pressures.

D. Clean shaft and bottom of loose material immediately before placing reinforcement and concrete. Provide temporary means and methods, as required, to remove water to 3 inches or less from soil borings, or as directed by the Geotechnical Engineer.

1. When slurry displacement method is used, conform to the requirements of ACI 336.1.

E. Allow inspection of shaft and liner prior to placement of reinforcement and concrete.

F. Place reinforcing steel in accordance with Section 03 20 00.

G. Place concrete in single pour, in accordance with Section 03 30 00 with equipment designed for vertical placement of concrete.

H. Coordinate casing withdrawal with concrete placement so that concrete pressure head exceeds anticipated outside soil and water pressure above bottom of casing at all times during withdrawal.

I. Extend reinforcement for connection of caps.

J. Set tops of piers to elevations indicated.

3.6 TOLERANCES

A. Install piers with maximum variation from location, plumbness, bottom area, diameter, and anchorage locations as specified in ACI 336.1.

B. Locate centerline of piers within the following tolerances:

1. Maximum permissible variation of location not more than 1/24 shaft diameter or 3 inches, whichever is less.

2. Shafts out of plumb, not more than 1.5 percent of length nor exceeding 12.5 percent of shaft diameter or 15 inches, whichever is less.

3. Concrete cut-off elevation, plus 1 inch to minus 3 inches.

4. If above tolerances are exceeded, provide additional or corrective construction to compensate for excessive eccentricity subject to approval of the District's Representative.

5. Submit proposed corrective construction methods to the District's Representative for review before proceeding.

3.7 DEWATERING

A. Comply with requirements of Section 01 50 00 – Temporary Facilities.

B. Do not allow water to accumulate in Piers.

3.8 OVERDRILLING

A. No payment will be made for extra length, when pier shafts are excavated to a greater depth than required or authorized by the District's Representative, due to over-drilling by Contractor.

B. Complete Pier and fill extra depth with concrete, if other conditions are satisfactory.

3.9 STEEL CASINGS

A. Install steel casing as excavation work progresses as required to ensure stability of Pier shaft walls. Remove and replace or repair casings which are damaged during installation, and which could impair strength or efficiency of completed Pier.

3.10 REINFORCING STEEL

A. Fabricate and erect reinforcing cages in accordance with provisions of Section 03 20 00 – Concrete Reinforcement.

B. Provide reinforcing cage as one continuous unit using inner ring reinforcing steel.

C. Place reinforcement accurately and symmetrically about axis of hole and hold securely in position during concrete placement.

D. Use templates to set reinforcing dowels. Provide blocking and holding devices to maintain required position during concrete placement.

E. Protect exposed ends of dowels from mechanical damage and exposure to weather.

3.11 CONCRETE PLACEMENT

A. General: Fill Piers with concrete immediately after inspection and approval by the District's Representative. Use protection sheets (cut out to receive concrete), extending at least 48 inches beyond edges of excavation openings.

1. Place concrete continuously and in a smooth flow without segregating the mixed materials. Provide mechanical vibration for consolidation of at least top 30 feet of each shaft.

2. Place concrete by means of a tremie pipe.

   a. Control placement operations to ensure that tremie pipe is not broken during continuous placing from bottom to top.

   b. Other methods of depositing concrete underwater may be used, if acceptable to the District's Representative.

3. Maintain a sufficient head of concrete to prevent reduction in diameter of pier shaft by earth pressure and to prevent extraneous material, slurry or water from mixing with fresh concrete. Maintain bottom of tremie at least 10 feet below the rising surface of the fresh concrete.

4. Coordinate withdrawal of temporary casings with concrete placement operations to maintain a head of concrete approximately 5 feet above casing bottom.

5. Stop concrete placement at cut-off elevation shown, screed level, and apply a scoured, rough finish. Where cut-off elevation is above ground elevation, form top section above grade and extend shaft to required elevation.

6. Interrupted placing operations of over 1 hour duration will require a cold joint installation.
    a. Leave resulting shaft surface approximately level and insert steel dowels as shown on drawings.
    b. At resumption of concrete placing, clean off surface laitance, roughen as required, and slush with a 1 to 1 cement grout before remainder of concrete is placed.

B. Hot Weather Placement: Provide in accordance with provisions of Section 03 30 00 – Cast-in-Place Concrete.

3.12 FIELD QUALITY CONTROL

A. Place two four-inch diameter PVC pipe inspection conduits near the center of each pier (at roughly the third points of the diameter, but not nearer than two inches to the vertical reinforcing). Cap the lower ends of the inspection conduits to keep the conduits free of concrete and other debris. After the piers are completed and accepted by the District's Representative, fill conduits with a fluid cementitious grout with the same compressive strength as the pier concrete.

B. Provide for field quality control and quality assurance testing and inspection for concrete and reinforcing steel as specified in Section 03 20 00 – Concrete Reinforcement and Section 03 30 00 – Cast-in-Place Concrete.

3.13 FIELD QUALITY ASSURANCE

A. The District's Representative will perform and report specified tests, and additional tests which may be required.
    1. Each pier will be inspected and tested before placing concrete.
        a. The Contractor shall provide facilities as required to assist inspection and testing of excavations and cooperate with inspecting and testing personnel to expedite work.
        b. The Contractor shall notify the District's Representative at least 48 hours prior to time excavations will be ready for inspection and tests.

B. The District's Representative will:
    1. Inspect drilling of piers.
    2. Verify drilling depth of piers.
    3. Inspect placement of reinforcement for conformance with the Contract Documents.
    4. Inspect placement of concrete in accordance with the Contract Documents.
    5. Perform non-destructive testing of the Piers using cross-hole sonic logging (CSL) techniques via the inspection conduits if the quality of the completed Piers is in doubt or needs to be confirmed.

6. Conduct tests and provide reports so as not to delay concreting operations for acceptable excavations.

3.14 UNACCEPTABLE PIERS

A. Unacceptable Piers: Piers that are placed out of position, are below elevations, or are damaged. Piers that have not passed the inspection of the shaft and liner prior to placing the concrete.

B. Provide additional piers or replace piers failing to comply with specified requirements.

3.15 MEASUREMENT AND PAYMENT

A. Basis of Bids: Bids shall be based on number of piers, design length from top elevation to bottom shaft and diameter of shaft, as required to support all design loads in accordance with the design criteria set forth in the Geotechnical Report.

B. Basis for Payment:

1. There will be no additional compensation for excavation, drilling, concrete fill, reinforcing, casings, or other costs associated with achieving the project requirements.

2. No additional payment will be made for unacceptable piers.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Weed Control and Prevention.
2. Pest Control and Prevention.
3. Disease Control and Prevention.
4. Fertilization.
5. Pruning of Plant Material.
6. Replacement of Dead or Unhealthy Plant Material.
7. Repair of Staking and Guying System.
8. Watering Plant Material.
9. Monitoring, Adjustment and Repair of Irrigation System.
10. Monitoring Changing Soil Moisture and Weather Conditions Relative to Plant Material Water Requirements.
11. Adjusting Length of Watering Cycles According to Changing Soil and Weather Conditions.

B. For Irrigation, see Section 32 84 00.

C. For Soil Preparation and Soil Mixes, see Section 32 91 13.

D. For Plant Material, see Section 32 93 00.

1.2 DEFINITIONS

A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of Owner’s representative in writing.

B. IPM — Integrated Pest Management: An approach to pest control that utilizes regular monitoring to determine if and when treatments are needed and employs physical, mechanical, cultural, biological and educational tactics to keep pest numbers low enough to prevent intolerable damage or annoyance. Least-toxic chemical controls are used as a last resort.

1.3 REFERENCES

A. ANSI — American National Standards Institute:
1. Z60.1 — American Standard for Nursery Stock. Most current edition.
2. A300 – Pruning. Most current edition.

B. NAA — National Arborist Association:
1. Pruning Standards for Shade Trees. Most current edition.

C. ICBN — International Code of Botanical Nomenclature.

D. ICNCP — International Code of Nomenclature of Cultivated Plants.

E. ISA — International Society of Arboriculture.

1.4 SUBMITTALS

A. Product Purchase and Delivery Documentation:
   1. Fertilizer: Within 5 working days of each application submit purchase orders, invoices and receipts showing supplier name and address, person who sold product, date of purchase, specific product purchased, quantity purchased, and delivery date.

B. Manufacturer's Current Printed Instructions:
   1. Fertilizer.
   2. Required chemicals.

C. Documentation of Accepted Conditions: Within 7 working days after Owner's acceptance of maintenance, submit color photographs and a written report documenting the accepted conditions of the plant material.

D. Inspection Reports:
   1. Monthly plant inspection report documenting signs of stress.

1.5 QUALITY ASSURANCE

A. Contractor Qualifications:
   1. Maintenance Contractor: Minimum 10 years experience in maintenance of commercial landscape projects.
   2. Maintenance Supervisor: Minimum of 10 years experience in landscape maintenance supervision, with experience and training in integrated pest management, turf management, entomology, pest control, soils, fertilizers and plant identification.
   3. Labor Force: Thoroughly familiar and trained in the work to be accomplished and perform the task in a competent, efficient manner acceptable to the Owner.
   4. Supervision: Directly employ and supervise the Work force at all times.

B. Notification of Change in Supervision: Notify Owner of changes in supervision.
   1. Identification: Provide proper identification for landscape maintenance firm's labor force.

C. Regulatory Requirements:
   1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
   2. Provide for inspections and permits required by Federal, State, or local authorities in furnishing, transporting, and installing of chemicals.
   3. Submit a record of herbicides, insecticides and disease control chemicals used to the County Agricultural Commissioner's Office as required by law.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Plant Material: Meet requirements of Section 32 93 00.

1.7 SITE CONDITIONS

A. Environmental Requirements:
   1. Do not apply chemicals during windy conditions.

1.8 SEQUENCING AND SCHEDULING

A. Work Schedule:
   1. Perform maintenance during hours accepted by Owner.
   2. Be present at the project site at least once a week and as often as necessary to perform specified maintenance.

B. Chemical Applications:
   1. Notify Owner in advance of required chemical applications.
   2. Obtain Owner's approval of application schedule.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Gro-Power Products:
   1. Gro-Power Co. – www.gropower.com.
   2. Or equivalent and accepted substitute.

B. Other Fertilizers:
   1. Agri Tab Corporation – www.agritab.com.
   2. Or equivalent and accepted substitute.

C. Rock Mulch:
   1. Lyngso – www.lyngsogarden.com
   2. American Soil and Stone – www.americansoil.com.
   3. Or equivalent and accepted substitute.

D. Herbicide:
   1. Round-Up – www.roundup.com.
   2. Or equivalent and accepted substitute.

E. Polymer:
   1. Complete Green, El Segundo, CA, www.completegreencompany.com
   2. Or equivalent and accepted substitute.

2.2 MATERIALS

A. Replacement Plant Material:
   1. Match existing genus, species, cultivar and size.
   2. Meet requirements of Section 32 93 00.
   3. Meet requirements of ANSI Z60.1, ICBN and ICNCP.

B. Fertilizers:
   1. Gro-Power Plus 5-3-1.
   2. Gro-Power Hi-Nitrogen (14-4-9) and Gro- Power Premium Hi-Nitrogen 18-3-7.
   3. Gro-Power Controlled Release 12-8-8.
   4. Gro-Power Flower 'N' Bloom 3-12-12.
   5. Or accepted substitute.

C. Fertilizer Tablets for Replacement Plants:
   1. Gro-Power 21 Gram Planting Tablets 20-10-5.
   2. Or accepted substitute.

D. Herbicides, Insecticides, and Fungicides:
   1. Legal commercial quality non-staining materials with original manufacturers' containers, properly labeled with guaranteed analysis, least toxic required.

E. Replacement Staking and Guying Materials:
   1. Same as original installation.

F. Mulches:
   1. Same as original installation.

G. Polymer: Soil drain / PAM.

PART 3 — EXECUTION

3.1 PREPARATION

A. Protection of Existing Conditions:
   1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
   2. Provide barricades, fences or other barriers to protect existing conditions from damage during maintenance operations.
   3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants.
   4. Submit written notification of damaged plants and structures to Owner and Owner's representative immediately.

3.2 GENERAL MAINTENANCE

A. Maintenance Period for all planting: Continuously maintain each plant and each portion during progress of work, and for a minimum period of 365 days after Final completion until Owner accepts maintenance.

B. Integrated Pest Management: Employ principles of integrated pest management for each aspect of maintenance.

3.3 TREE, SHRUB AND VINE MAINTENANCE

A. Watering:
   1. Using a soil sample tube, check rootball moisture and surrounding soil moisture at representative plants at least twice a week.
   2. Maintain watering basins around trees and shrubs so that enough water can be applied to establish moisture through root zones.
   3. In rainy season, open basins to allow surface drainage away from the root crown where excess water may accumulate.
   4. Restore watering basins at end of rainy season.

5. Adjust frequency and length of time for watering cycles according to changing soil and weather conditions.
6. For supplemental hand watering of watering basins, use a water wand to break the water force.
7. Do not permit crown roots to become exposed to air through dislodging of soil and mulch.
8. Maintain depth of mulch to reduce evaporation and frequency of watering.

B. Settled or Leaning Plants: Reset plants to proper grades or upright position.

C. Weed Control:
1. Keep mulched areas between plants and watering basins weed free.
2. As a last resort use least toxic herbicides.
3. Avoid frequent soil cultivation that destroys shallow roots.

D. General Pruning:
1. Meet requirements of Pruning Standards for Shade Trees.
2. Prune trees to eliminate diseased or damaged growth.
3. Reduce toppling and wind damage by thinning out crowns.
4. Prune trees to maintain growth within space limitations, maintaining a natural appearance and balancing crown with roots.
5. Retain lower branches in a “tipped back” or pinched condition to promote caliper trunk growth.
6. Do not cut back to fewer than six buds or leaves on branches.
7. Prune damaged trees or those that constitute health or safety hazards at any time of year.
8. Make cuts clean and close to the trunk, without cutting into the branch collar.
9. Make larger cuts (one inch in diameter or larger) parallel to shoulder rings, with the top edge of the cut at the trunk or lateral branch.

E. Staking:
1. Inspect stakes and guys at least once a week to check for rubbing that causes bark wounds.
2. Adjust tree ties and guy cables as often as required to allow tree caliper growth and prevent bark wounds.
3. Replace defective materials with materials to match original materials.

F. Fertilizing Acid Loving Plants:
1. Feed 1 tablespoon of 3-12-12 fertilizer per each foot width of plant.
2. Spread evenly around plant and water thoroughly.
3. Start feeding when buds have formed until the plant is finished blooming at approximately 4 week intervals.

G. Replacement of Plants: Replace, without cost to Owner, and as soon as weather conditions permit, plants not in a vigorous, thriving condition, during and at the end of the maintenance period.

3.4 GROUND COVERS

A. Watering:
1. Using a soil sampling tube, check for moisture penetration throughout the root zone at least twice a week.
2. Water as frequently as necessary to maintain healthy growth of groundcovers.
3. Adjust frequency and length of time for watering cycles according to changing soil and weather conditions.

B. Weed Control:
   1. Maintain mulch layer.
   2. Minimize hoeing of weeds to avoid plant damage.
   3. As a last resort use least toxic herbicides required.

C. Fertilization During Growing Season:
   1. Apply Gro-Power Plus at 30 pounds per 1,000 square feet every 10 weeks after planting until Owner accepts maintenance.
   2. Meet requirements of manufacturer's current printed instructions.
   3. Apply fertilizers evenly over planting areas by spreading half the fertilizer in one direction and half in a direction 90 degrees to the first direction to assure even application.
   4. Apply dry fertilizers with either a broadcast centrifugal or gravity spreader on planting bed areas.
   5. Water planting areas thoroughly after application.

D. Replacement of Ground Cover: Replace, without cost to Owner, and as soon as weather conditions permit, ground cover plants not in vigorous, thriving condition, during and at the end of the maintenance period.

3.5 ANNUALS, PERENNIALS AND ACID LOVING PLANTS

A. Watering:
   1. Hand-water pots and planters that do not have an automatic irrigation system.
   2. Species, sizes of plants, container sizes and orientation shall dictate frequency of watering.
   3. Using a soil sample tube, check rootball moisture and surrounding soil moisture at representative plants at least twice a week.
   4. Adjust length of watering cycles as often as required according to changing soil and weather conditions.

B. Drainage of Pots:
   1. After watering and rainfall, siphon standing water from bottom of all pots which do not have drain holes.
   2. Provide siphon well pipes as required.

C. Weed Control:
   1. Hand pull weeds from planted areas every week.
   2. Smooth out disturbed soil and mulch.
   3. Replace mulch and soil mix as required.
   4. Match existing soil mix and mulch.

D. Pruning:
   1. Limit pruning to removal of damaged or dead twigs and foliage.
   2. Remove spent flowers on a weekly basis.

E. Fertilizing Acid Loving Plants:
   1. Feed 1 tablespoon of 3-12-12 fertilizer per each foot width of plant.
   2. Spread evenly around plant and water thoroughly.
   3. Start feeding when buds have formed until the plant is finished blooming at approximately 4 week intervals.

F. Fertilizing Annuals and Perennials:
1. Sprinkle 3-12-12 fertilizer at the rate of 1-1/2 to 2 lbs. per 100 square feet and water thoroughly.
2. Wash any fertilizer material from plant leaves.
3. Feed during the growing season when blooming begins at 4 week intervals.
4. Alternate feeding with 12-8-8 fertilizer per bag directions.

G. Replacement of Annuals:
1. Remove annuals when materials exhibit a “spent” condition.
2. Thoroughly cultivate soil after removal of “spent” or “dead” plants prior to planting new materials.
3. Incorporate slow release fertilizers and rake smooth.
4. Install accepted replacement plants.

3.6 INSECTS, PESTS, AND DISEASE CONTROL

A. General:
1. Employ principles of IPM in the selection of preventative and control measures for plant pests and diseases.
2. Insignificant pests will be tolerated providing they do not seriously threaten planting health and appearance.
3. Monitor the site closely and take timely action to address problems identified.
4. Use personnel licensed and experienced using materials approved by the EPA and conform to applicable laws, codes and regulations, under the direction of a licensed certified pest control operator.
5. Spray with extreme care to avoid hazards to any person, pet, or automobile in the area or adjacent areas.
6. Meet requirements of chemical manufacturer’s current printed instructions.
7. The Contractor shall be held liable for plant damage due to the use of chemicals.

B. Inspection:
1. Inspect plant material weekly for signs of stress and damage.
2. Submit a written and photographic inspection report of findings monthly to Owner and Owner’s representative.

C. Spraying:
1. When necessary apply the least toxic chemical required for the existing problem.
2. Apply in strict accordance with manufacturer’s current printed instructions.
3. Apply sprays only if a pest or disease is a serious threat and cease application after problem is under control.

3.7 IRRIGATION SYSTEM

A. Damages:
1. Repair without charge to Owner damages to system caused by Contractor’s operations.
2. Perform repairs within one watering period.

B. Cleaning and Monitoring the System:
1. Continually monitor the irrigation systems to verify that they are functioning properly as designed.
2. Clean filters and strainers at least once a month and as often as necessary to keep the irrigation systems free of sand and other debris.

3. Set and continuously adjust and program automatic controller for seasonal water requirement.
4. Make program adjustments as required by changing field conditions.
5. At least once a week, daily when required, use a soil sampling tube to check the rootball moisture of representative plants as well as the surrounding soil.
6. Prevent spraying on windows, building walls, and game courts, etc. by balancing the throttle control on the remote control valves and the adjustment screws on the sprinkler heads.
7. Do not allow water to atomize and drift.

3.8 FIELD QUALITY CONTROL

A. Maintenance Review:
   1. At the end of the maintenance period, request a review by the Owner's representative to determine whether maintenance Work meets the requirements of the Contract Documents.
   2. Submit a written request at least five working days prior to the anticipated date of review.
   3. If it is found that the maintenance Work does not meet the requirements of the Contract Documents, the Contractor will receive written notification from the Owner's representative of corrective Work preventing Owner acceptance of the maintenance Work.
   4. Perform corrective Work within ten calendar days after the review.
   5. Upon completion of the corrective Work, request another review to determine whether the maintenance Work meets the requirements of the Contract Documents.
   6. Corrective Work followed by review will be required until the corrective Work is found by the Owner's representative to meet the requirements of the Contract Documents.

B. Payment for Additional Maintenance Review Field Trips: If additional trips are required after the first review because of incomplete work, reimburse Owner for expenses and fee required to have Owner's representative make additional field trips.

C. Owner's Acceptance of Maintenance:
   1. When the Owner's representative determines that the maintenance Work conforms to the requirements of the Contract Documents the Contractor will receive written notification designating the day which the Owner will accept maintenance responsibility.
   2. Continue maintenance of landscape Work until the Owner accepts maintenance.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for furnishing, spreading, and compacting aggregate base course for pavements as indicated.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

B. ASTM D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

C. ASTM D3017 Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

D. State of California, Department of Transportation (Caltrans), Standard Specifications:

E. Section 17 Watering

F. Section 26 Aggregate Bases

G. State of California, Department of Transportation (Caltrans), Standard Test Methods:

Calif. Test 201	Method of Soil and Aggregate Sample Preparation Aggregates
Calif. Test 202	Method of Tests for Sieve Analysis of Fine and Coarse Aggregates
Calif. Test 205	Method of Determining Percentage of Crushed Particle
Calif. Test 216	Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates
Calif. Test 217	Method of Test for Sand Equivalent
Calif. Test 229	Method of Test for Durability Index
Calif. Test 301	Method of Test for Resistance “R” Value of Treated and Untreated Bases, Subbases and Basement Soils by the Stabilometer

PART 2 - PRODUCTS

2.1 AGGREGATE BASE MATERIAL

A. Class 2 aggregate base shall be free of vegetable matter and other deleterious substances. Coarse aggregate, material contained on the No. 4 sieve, shall consist of material of which 25 percent by weight shall be crushed particles as determined by California Test Method No. 205. Class 2 aggregate base shall conform to one of the following gradings, determined in accordance with California Test Method No. 202:

Percentage Passing Sieves

Sieve	3/4 inch Maximum
2 inch	—

1 ½ inch	—
1 inch	100
3/4 inch	90-100
No. 4	35 - 55
No. 30	10 - 30
No. 200	2 - 9

B. Class 2 aggregate base shall conform to the following additional requirements:

Tests	Test Method No. Calif.	Requirements
Resistance (R-Value)	301	78 min.
Sand Equivalent	217	22 min.
Tests	Test Method No. Calif.	Requirements
Durability Index	229	35 min.

C. Aggregate base for bioretention area shall be permeable Class 2, 3/4" maximum. When the aggregate base is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the area to be covered with aggregate base.

D. Geotextile Fabric: Mirafi FW300 or equivalent

2.2 SOURCE QUALITY CONTROL

A. Submit certificate of compliance for approval prior to installation of material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Call for an inspection by the Engineer and obtain written acceptance of the prepared subgrade or subbase before proceeding with the placement of aggregate base course.

B. The subgrade or subbase to receive aggregate base course, immediately prior to spreading, shall conform to the compaction and elevation tolerances indicated for the material involved and shall be free of standing water and loose or extraneous material.

3.2 INSTALLATION STANDARDS

A. Aggregate base course shall be applied over the prepared subgrade or subbase and compacted in accordance with Section 26 of the Caltrans Standard Specifications.

B. Aggregate base course shall be minimum uniform thickness after compaction of dimensions indicated. Where not indicated, compacted thickness shall be six inches for driveways/sidewalks and eight inches for roadways.

C. All compaction expressed in percentages in this section refers to the maximum dry density as determined by California Test Method No. 216.

3.3 SPREADING OF MATERIAL

A. Aggregate for base course shall be delivered as uniform mixture of fine and coarse aggregate and shall be spread in layers without segregation.

B. Aggregate base course material shall be free from pockets of large and fine material. Segregated materials shall be remixed until uniform.

C. Aggregate base material shall be moisture-conditioned to near optimum moisture content in accordance with the applicable requirements of Section 17 of the Caltrans Standard Specifications.

D. Aggregate base course six inches and less in thickness may be spread and compacted in one layer. For thicknesses greater than six inches, the base course aggregate shall be spread and compacted in two or more layers of uniform thickness not greater than six inches each.

3.4 COMPACTING

A. Relative compaction of each layer of compacted aggregate base material shall be not less than 95 percent as determined by California Test Method No. 216.

B. Thickness of finished base course shall not vary more than 3/4 inch from the indicated thickness at any point. Base which does not conform to this requirement shall be reshaped or reworked, watered, and recompacted to achieve compliance with specified requirements.

C. The surface of the finished aggregate base course at any point shall not vary more than 3/4 inch above or below the indicated grade.

3.5 FIELD QUALITY CONTROL

A. Perform field tests in accordance with ASTM D2922 to determine compliance with specified requirements for density and compaction of aggregate base material, and with ASTM D3017 to determine moisture-content compliance of the installed base course.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for providing asphaltic concrete paving as indicated.

B. Related Sections

1. Section 321123, “Aggregate Base”

1.2 REFERENCES

A. State of California, Department of Transportation (Caltrans), Standard Specifications

Section 39 Asphalt Concrete
Section 92 Asphalts
Section 93 Liquid Asphalts
Section 94 Asphaltic Emulsions

B. State of California, Department of Transportation (Caltrans), Standard Test Methods

Calif. Test 202	Method of Tests for Sieve Analysis of Fine and Coarse Aggregates
Calif. Test 304	Method of Preparation of Bituminous Mixtures for Testing
Calif. Test 366	Method of Test for Stabilometer Value
Calif. Test 375	Determining the In Place Density and Relative Compaction of AC Pavement

1.3 PROTECTION

A. Protect concrete pavements and walks, curbs and bases, and other improvements adjacent to the operations with suitable materials. The Contractor shall be responsible for any damage caused by the Contractor’s employees or equipment and shall make necessary repairs. Building and other surfaces shall be covered with paper or other protection, where required. All damage caused by the Contractor’s operations shall be prepared or replaced as required.

PART 2 - PRODUCTS

2.1 BASE COURSE MATERIAL

A. Class 2 Aggregate Base. Percentage composition by weight of aggregate base material shall conform to the 3/4 inch maximum grading when determined by California Test 202.

2.2 TACK COAT

A. Tack Coat: Diluted SS-1 or SS-1h emulsion or undiluted RS-1 emulsion in conformance with Section 94 or the Caltrans Standard Specifications.

2.3 ASPHALT PAVING MATERIALS

A. Paving Asphalt: All purpose, aged residue, steam refined, PG 64-10 grade, in accordance with Section 92 of the Caltrans Standard Specifications.

B. Aggregate: Type A, with the grading of the combined aggregate conforming to 1/2 inch maximum size, medium grading, as specified in Section 39 of the Caltrans Standard Specifications.

C. Mixing Facilities: Asphalt concrete surfacing material shall be furnished from an approved commercial asphalt central mixing plant.

2.4 SOURCE QUALITY CONTROL

A. Contractor shall submit Certificate of Compliance from manufacturer for approval prior to installation.

PART 3 - EXECUTION

3.1 PLACING OF BASE COURSE

A. The Contractor shall call for an inspection by the Engineer and obtain written approval of the subgrade before proceeding with the base course.

B. Base course shall be minimum uniform thickness after compaction of dimensions indicated.

C. Base course shall be placed over finished subgrade and compacted in accordance with Section 32 11 23 - Aggregate Base.

D. After base course has been completed, the Contractor shall call for an inspection by the Engineer and obtain written approval before proceeding with application of the asphalt wearing surface.

3.2 PLACING OF TACK COAT

A. The Contractor shall call for an inspection by the Engineer and obtain written approval of the subgrade before proceeding with the tack coat.

B. The tack coat shall be applied using a calibrated distributor truck spray bar, hand spraying, squeegee and brush application in locations where required and per manufacturers requirements. Tack coat shall be applied in accordance with Section 39-4 of the Caltrans Standard Specifications at the rate of from 0.22 to 0.28 gallons per square yard.

3.3 PLACING ASPHALT CONCRETE

A. Areas to be paved shall be covered with a layer of hot asphalt concrete surfacing not to exceed 3.0 inches after compaction.

B. Paving asphaltic concrete shall be delivered, laid, rolled, and finished in accordance with Section 39 of the Caltrans Standard Specifications.

C. Before placing asphalt concrete, a tack coat (paint binder) shall be applied to all vertical surfaces against which asphalt concrete surfacing will be placed. Tack coat shall be applied in accordance with Section 39-4 of the Caltrans Standard Specifications at the rate of from 0.02 to 0.10 gallons per square yard.

D. Finish surface of the wearing course shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, cold joints, or other irregularities.

E. Finish paving shall conform to slopes, lines, and finish grades indicated, and shall drain properly. Where adjacent surfaces are intended to be flush (as at concrete gutters, walks, and paving), they shall conform smoothly at all joints.

F. Ridges, indentations, and other objectionable marks left in the surface of the asphalt concrete by paving or rolling equipment shall be eliminated by rolling. The use of equipment that leaves ridges, indentations, or other objectionable marks in the asphalt concrete shall be discontinued, and other acceptable equipment shall be employed.

G. Where cold joints are indicated or necessary, cut back the placed and compacted cold asphalt a minimum of three inches with a concrete or masonry power saw, so that a vertical face of compacted full thickness material is exposed. Treat this surface with a tack coat before proceeding with the placement of new asphaltic concrete surfacing.

H. Finish paving shall conform to finish elevations within plus or minus 0.01 of a foot and shall be level to within plus or minus 1/4 inch in 10 feet when measured with a 10 foot straightedge in any direction.

3.4 FIELD QUALITY CONTROL

A. The Contractor shall control the quality of the work and shall provide adequate testing to assure compliance with these Specifications.

B. After completion of paving work, all paving shall be flooded with water, and any resulting “ponds” shall be ringed with chalk. Such hollows shall be corrected with addition of asphalt paving materials and rerolling until all paving is completely level and free from hollows and high spots.

C. The Engineer shall perform in-place density and compaction tests of the completed pavement in accordance with California Test 375 to determine compliance with specified requirements. Test shall be performed as often as necessary to verify compliance, but not less frequently than the following:

1. One test required.

3.5 MAINTENANCE OF PAVEMENT

A. Upon completion of final rolling, traffic shall not be permitted on the finished pavement

for at least six hours, and until the asphalt concrete has cooled sufficiently to withstand traffic without being deformed. Finished pavement shall be maintained in finished clean condition until the work is accepted by the Engineer.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section Includes: Provide concrete curbs and gutters, ramps, walkways, pavers as shown on the Drawings and as specified herein.

1.2 REFERENCE SPECIFICATIONS

A. Wherever the words "Standard Specifications" are referred to, the reference is to the State of California, Department of Transportation, Standard Specifications, latest edition.

1.3 SUBMITTALS

A. Submit certificate of compliance indicating that the concrete complies with the specifications as Product Information submittals.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Comply with the Standards Specifications, Paragraph 73-1.01.

1. Cement: Type II Modified.
2. Provide air-entrainment of three percent with admixture conforming to ASTM C260.
3. Nominal size of large aggregate shall be 1”.
4. Minimum strength of concrete shall be 4000 psi at 28 days.
5. Bar reinforcement to be ASTM A615, Grade 60.
6. Coloring Admixtures for colored concrete to be ASTM C 979, Chromix Admixture, color as indicated on landscape drawings, as available from L. M. Scofield Company, Los Angeles, California (213)-723-5285, or Engineer approved equivalent.
7. Surface Retarder for colored concrete to be Top-Cast Surface Retarder, as available from Dayton Superior, www.daytonsuperior.com, or Engineer approved equivalent.

2.2 DOWELLED-IN CONCRETE BUFFER / ISLAND

A. See Section 2.1 Concrete for materials.

1. Minimum strength of concrete shall be 4000 psi at 28 days.
2. Bar reinforcement to be ASTM A615, Grade 60.

3. Asphaltic emulsion shall be applied to the surface of existing pavements preparatory to resurfacing with hot mix asphalt, and to all concrete surfaces which will be in contact with hot mix asphalt surfacing. Asphalt emulsion shall be SS-1H. The Contractor shall submit a copy of Certificate of Compliance for asphaltic emulsion.

4. Epoxy Adhesive Compound: Epoxy adhesive compound shall be Sikadur Hi-Mod, Sikadur Hi-Mod Gel, as manufactured by the Sika Chemical Corporation, represented by William C. Hodges, 467 Lincoln Ave., Palo Alto, CA 94301; Concresive 1001 LPL, Concresive AEX 1438, as manufactured by Adhesive Engineering Co., 1411 Industrial Road, San Carlos, CA 94070, or Engineer approved equivalent.

2.3 PAVER

A. Paver shall be 12” x 12” Pewter Concrete Stepping Stone or equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with the Standard Specifications, Section 73, Paragraph 1.03 Construction, inclusive, except as modified in the plans and herein.

B. Unless shown otherwise on the Drawings, replace existing curbs and sidewalks in kind within the City of Berkeley right-of-way.

C. Adjust structures such as valve boxes, manhole frames and covers, and electrical vaults to grade after the curb and gutter or sidewalk has been constructed for a reasonable distance on all sides of the structure. Complete the concrete work after the structure is adjusted.

D. New traffic rated concrete driveway/sidewalk within the City of Berkeley right-of-way shall have #4 rebar at 18-inches each way and shall be colored with 1-1/2 pounds of lamp black per cubic yard to match existing concrete sidewalk. Tie wire for reinforcement shall be eighteen (18) gauge or heavier black annealed conforming to the requirements of ASTM Designation A82.

E. When installing concrete curbs, gutters, and sidewalks within the City of Berkeley right-of-way the Contractor shall provide continuous access and concrete protection by whatever means necessary for the concrete until it dries. The Contractor shall replace any new concrete that is marked with graffiti before it dries at no additional cost to the Owner.

F. Control and expansion/construction joints shall be located and installed as indicated in the plans.

G. Concrete finish shall be as indicated in the plans.

3.2 FIELD QUALITY CONTROL

A. Field Samples:

a. Provide (1) 18” x 18” x 6” segment of concrete planter wall mock-up for review. Include the finish, control joints, expansion joints materials, and edge treatments.

b. Provide (4) 12” x 12” x 4” mock-up of colored concrete flatwork for review. Include the specified color admixture, finish, control joints, expansion joints materials. Provide (2) colors each with (2) finish levels for a total of (4) panels.

END OF SECTION

PART 1 - GENERAL

1.0 SECTION INCLUDES

A. Traffic striping and control markings on pavement, parking stall striping, and painted curbs.

1.1 RELATED DOCUMENTS

A. State of California, Department of Transportation (Caltrans), Standard Specifications and Manuals – Latest Edition:
   1. Section 84 Traffic Stripes and Pavement Markings.
   2. Traffic Manual Standard Drawings – Latest Edition.

B. State of California, Department of Transportation (Caltrans), Standard Test Methods:
   1. Calif. Test 669 Testing for Specification Compliance of Non-Reflective and Reflective Pavement Markers.

C. California Air Resources Board (CARB):
   1. CARB/VOC Permissible Content of Volatile Compounds (VOC in Paints)

D. CA Title 24 – ADA Pavement Markings

1.2 RELATED SECTIONS

A. Section 32 12 16, Asphalt Paving.

B. Section 32 16 13, Concrete Curbs, Gutter and Sidewalks.

1.3 SUBMITTALS

A. Shop Drawings: Submit drawings and diagrams and colors, indicating stripe width of roadway divider stripes and parking stalls, configuration and dimensions of directional arrows, style and size of letters for compact car and electric car, designations, configuration and dimension of international accessible symbol, where coating is applied by color section and enabling calculations of total square feet by color, and any other traffic control markings on pavement.

B. Color Samples: Submit manufacturer’s color charts or sample drawdowns of colors to be applied.

C. Product Data: Submit manufacturer's Technical Data Sheets (TDS) and Safety Data Sheets (SDS of products being applied.

D. Application Instructions/Rates: Submit manufacturer's application instructions/rates to achieve desired finished product dry mil thickness.

E. Maintenance Instructions: Submit maintenance and cleaning instructions.

F. Certificate of Compliance Certificate of Compliance: Submit evidence or affidavit, which certifies that paint to be used complies with latest CARB/VOC regulations.

PART 2 - PRODUCTS

2.0 MATERIALS

A. Traffic Line Paint:
   1. Provide paint conforming to the requirements of Section 84-3 of the Caltrans Standard Specifications, white in color for traffic striping, parking stalls, and other control markings on pavement, yellow in color for other traffic control markings where indicated, blue in color for accessible parking stalls, red in color for curbs where no parking is indicated, white in color for curbs where passenger discharge and pickup is indicated.

B. Thermoplastic Traffic Stripes and Pavement Markings:
   1. All striping and pavement markings shall be Thermoplastic where indicated on Contract Drawings and conform to either State Sepcifcations 8020-41G-19 or 8010-41G-21, including glass beads, conforming to the requirements of Section 84-2 of the Caltrans Standard Specifications.

C. Paint for parking stalls and ADA Striping shall be Waterborne, State Specification 8010 – 20B.

D. Curb paint

   1. Paint shall conform to the requirements in ASTM Designation: D 6628-01.
   2. Retroreflectivity of the paint traffic stripes and pavement markings shall conform to the requirements in ASTM Designation E 1710
   3. Paint type shall be Waterborne Traffic Line conforming to the requirements of Federal Specification TT-P-1952E.

E. Traffic Channelizer posts shall conform to CA MUTCD Section 3H.01. Each post shall have a minimum 2.25-inch diameter, be 42-inches tall and constructed of white PVC / polyethylene. Posts must have a minimum 3-inch by 12-inch retroreflective surface. Each post shall be equipped with an internal zinc-coated spring and mounted onto a rigid base designed for bolt/screw-in installation into asphalt. The posts shall be designed to withstand 60 mph impact while maintaining 360-degrees of flexibility.

F. Street Bond:
   1. Manufacturers
      a. Siplast (Irving TX) manufacturered pavement coating products.
         i. StreetBond SB120 Pavement Coating (Part A & B)
         ii. StreetBond Colorant
         iii. StreetBond Adhesive Promoter (for exposed stone in older asphalt)
         iv. StreetBond Sealer Concentrate

   2. Materials
      a. Asphalt Pavement Coating: A premium epoxy-modified, acrylic, waterborne coating designed for application on asphalt pavements receiving pedestrian traffic and minimal vehicular traffic. The coating shall be specially formulated to provide wear and crack resistance, color retention, adhesion, minimal water absorption and increased friction properties. Coating materials shall meet all local Volatile Organic Compounds (VOC) regulations.

         i. Coating Properties
            1. Solids by Volume: 54 - 61% (ASTM D2697)
            2. Solids by Weight: 71.5- 77.5% (ASTM D2369)
            3. Density: 14 lbs/gal (1.67 kg/l) (ASTM D1475)
            4. Drying Time: 1 – 4 hours at 77ºF (25°C) and 40% humidity (ASTM D5895)
            5. Taber Wear Abrasion Dry (H-10 wheel): 1.0g/1000 cycles after 1-day cure (ASTM D4060)
            6. Water Absorption: 3.5 – 6.5% (ASTM D471)
            7. Mandrel Bend: 1.0 – 1.5 inch (ASTM D522 - 93A)
            8. VOC Content: < 50 g/l
            9. Friction - Dry: 75 - 95 (ASTM E303)
            10. Permeance: 13.4 g/m^2/24hr/mmHg (52 mils) (ASTM D1653)

      b. Colorant: A highly concentrated, high quality, UV stable pigment blend designed to add color to the specified asphalt pavement coating.

      c. Adhesion Promoter: A liquid agent designed to enhance the adhesion fo the specified coating over surfaces with polished aggregates.

      d. Sealer Concentrate: A liquid sealer that is applied to a newly completed project to help seal coating and reduce dirt and tire pick-up.

PART 3 - EXECUTION

3.0 CONSTRUCTION

A. Provide traffic striping and control markings on pavement and parking stalls in accordance with the layout, configurations, and dimensions indicated on the Contract Drawings and

approved shop drawings. Prior to paint application, contractor shall coordinate a pre-application meeting with the owner to verify colors and their locations. Obtain approval from owner prior to paint application.

B. Paint application equipment shall conform to the requirements of the Caltrans Standard Specifications. Place markers in accordance with Section 85 of the Caltrans Standard Specifications.

C. All traffic striping, pavement markings (legend), and pavement markers removed shall be replaced except as modified in the Plans or as directed by the Engineer. Prior to replacement, the Contractor shall layout all striping patterns and marking locations by cat tracking or other suitable means for review and approval by the Engineer. Any striping and/or markings installed by the Contractor that the Engineer has not pre-approved, and that the Engineer determines are installed improperly or in the wrong location, shall be removed and replaced to the satisfaction of the Engineer at the Contractor's sole expense.

D. Surfaces which are to receive markings shall be thoroughly cleaned, free from loose materials and dry. Such areas shall be prepared by the Contractor to the satisfaction of the Engineer.

E. Any damage to existing or newly placed traffic striping due to the failure of the Contractor to protect the work, and correction of errors, shall be repaired by the Contractor at no additional cost.

F. Traffic control markings and parking stalls shall be applied with the use of substantial cutout patterns and templates, or with striping equipment which applies straight, uniform width, sharp lines. Coverage of paint shall be thorough and complete in accordance with the paint manufacturer's instructions and recommendations.

G. Traffic control markings and parking stalls shall be sharp and accurate, straight where required, without fuzziness at edges of lines.

H. Accessible parking stalls shall include the International Accessibility Symbol.

I. Thermoplastic Traffic Stripe Application:

   a. Use a ribbon extrusion or screed type applicator to apply a thermoplastic traffic stripe.

   b. Operate the striping machine at a speed of 8 mph or slower during the application of thermoplastic traffic stripe and glass beads.

   c. Apply a thermoplastic traffic stripe at a rate of at least 0.38 pounds per foot of 4-inch wide solid stripe. The applied thermoplastic traffic stripe must be at least 0.090 inch thick.

   d. Apply a thermoplastic pavement marking at a rate of at least 1.06 pounds per square foot. The applied thermoplastic pavement marking must be at least 0.100 inch thick.

e. Apply a thermoplastic traffic stripe and both types of glass beads in a single pass. Apply the thermoplastic 1st, followed immediately by consecutive applications of high-performance glass beads and then AASHTO M 247, Type 2 glass beads. Use 2 separate applicator guns for the glass beads, 1 applicator gun for each type of glass bead.

f. Contractor may apply glass beads by hand methods on pavement markings.

g. Distribute all glass beads uniformly on traffic stripes and pavement markings. Apply high-performance glass beads at a rate of at least 6 pounds per 100 square feet of stripe or marking. Apply AASHTO M 247, Type 2 glass beads at a rate of at least 8 pounds per 100 square feet of stripe or marking. The combined weight of the 2 types of glass beads must be greater than 14 pounds per 100 square feet of stripe or marking.

J. Curb paint application shall consist of two separate coats of traffic pain of the appropriate color to the face and top of curb. Nothing in these Specifications shall relieve the Contractor from their responsibilities as provided in Section 7-1.09, “Public Safety,” of the Standard Specifications.

K. Street Bond Coating Application:

a. Adhesion Promoter: For older asphalt with polished stone. Mix and apply according to manufacturer’s instructions and allow to dry completely prior application of the first layer of coating. If the asphalt substrate is newer without exposed polished stone an adhesive promoter is not needed.

b. Coating Application: Mix according to manufacturer instructions. Apply three (3) coats at the manufacturer specified rate of application to achieve a nominal dry mil thickness of 19 mils. Rough and/or porous asphalt surfaces may require an additional coat(s) to achieve desired dry mil thickness. Coating shall be applied by a heavy duty textured sprayer and back rolled, or roller, or brush applied according to the requirements published in the manufacturer’s installer’s guide. Allow each coat of material to dry before applying subsequent layers.

c. Sealer Concentrate: Mix according to manufacturer instructions and apply two (2) light coats using a low pressure handheld or backpack sprayer over coating application.

L. At completion, Contractor shall check the work thoroughly and shall touch-up traffic control markings and parking stalls which are not distinct or thorough in coverage, or which are not uniform in color.

3.1 FIELD QUALITY CONTROL

A. Perform tests in accordance with Caltrans Test 669 to verify compliance with Specification requirements.

B. Within 14 days of applying a thermoplastic traffic stripe or pavement marking with enhanced wet night visibility, the retroreflectivity must be a minimum of 700 millicandelas per square meter per lux for white stripes and markings and 500 millicandelas per square meter per lux for yellow stripes and markings. Test the retroreflectivity under ASTM E 1710. Have a reflectometer as described in ASTM E 1710 at the job site for making these measurements.

C. Thermoplastic traffic stripes and pavement markings with enhanced wet night visibility must consist of a single uniform layer of thermoplastic and 2 layers of glass beads as follows:

    a. The first layer of glass beads must be on the Authorized Material List under high-performance retroreflective glass beads for use in thermoplastic traffic stripes and pavement markings. The color of the glass beads must match the color of the stripe or marking to which they are being applied.

    b. The 2nd layer of glass beads must comply with AASHTO M 247, Type 2.

D. Both types of glass beads must be surface treated for use with thermoplastic under the bead manufacturer's instructions.

END OF SECTION

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fabrication of Site Furnishings.
   2. Placement of Site Furnishings.

B. For Site Concrete see 32 13 16.

1.2 DEFINITIONS

A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of Owner’s representative in writing.

B. Well Managed: “Well-managed” shall mean forests that are being managed through professionally administered forestry management and logging plans that ensure regeneration of desired species so that timber growth equals or exceeds harvesting rates in both quantity and quality over the long term. Other considerations include protecting rivers and streams from degradation, minimizing damage to the forest when harvesting, promoting biodiversity, operating in concert with the lawful interests of local populations, and maximizing both the yield and value of the forest products.

1.3 REFERENCES

A. ASTM — American Society for Testing Materials:
   1. A 185/A185M — Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement. Most current edition.
   2. A 615/A615M — Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. Most current edition.
   3. C 33 — Specification for Concrete Aggregates. Most current edition.
   4. C 140 — Method of Sampling and Testing Concrete Masonry Units. Most current edition.
   5. C 150 — Specification for Portland Cement. Most current edition.
   6. C 330 / C 330M — Specification for Lightweight Aggregates for Structural Concrete. Most current edition.
   7. C 881/C881M — Specification for Epoxy-Resin-Base Bonding Systems for Concrete. Most current edition.
   8. C 979 — Specification for Pigments for Integrally Colored Concrete. Most current edition.
   9. C 1116 / C 1116M — Specification for Fiber-Reinforced Concrete. Most current edition.

B. Uniform Building Code (UBC). Most current edition.

C. Standard Grading and Dressing Rule No. 15, West Coast Lumber Inspection Bureau (SCLIB). Most current edition.

D. American Lumber Standards Committee (ALSC).

E. Product Standard 1 of the U.S. Dept. of Commerce (PS-1). Most current edition.

F. Forest Stewardship Council (FSC).

G. American Wood Preservers' Association (APE).

1.4 SUBMITTALS

A. Samples: Wood/Steel for Site Furnishings: 6-inch segment of finish for each material and condition

B. Product Data:
   1. Café Chair
   2. Café Table
   3. Lounge Chair
   4. Low Coffee Table
   5. Trash and Recycling Receptacles
   6. Tree grate
   7. Skate Deterrent

C. Shop Drawings:
   1. Requirements:
      a. Show shop and erection details, to scale, including dimensions, sizes, thicknesses, gauges, finishes, joining, attachments, holes, welds, bolts, elevations and relationship of work to adjoining construction. Prepare details at not less than 3 inches = 1 foot.
      b. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from the Drawings.
      c. Indicate welded connections using AWS A2.0 welding symbols.
   2. Provide shop drawings for the following:
      a. Tree grate

D. Manufacturer's Current Printed Instructions:
   1. Furniture Manufacturer's Cleaning Instructions.

1.5 QUALITY ASSURANCE:

A. Fabricator Qualifications:
   1. Established reputation having work similar to that specified, in use for a minimum of 5 years.
   2. Shop shall have proper equipment for Work specified, including application of finish.
   3. Fabricators and finishers shall be recognized experts in the Work they are engaged to perform.

B. Regulatory Requirements:

1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over such Work.
2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.

1.6 DELIVERY, STORAGE AND HANDLING

A. Loading and Shipment:
   1. Carefully pack the units for shipment free from stains and other deleterious material.
   2. Exercise precautions against damage in transit.

B. Storage:
   1. Store units on non-staining wood skids or pallets at least four inches above grade.
   2. Place and stack skids and units to distribute weight evenly and to prevent breakage or cracking.
   3. Protect and store units from weather and soiling with waterproof non-staining covers or enclosure but allow air to circulate around units.

C. Handling:
   1. Handle units to prevent chipping, breakage, soiling or other damage.
   2. Do not use pinch or wrecking bars without protecting edges of units with wood or other rigid materials.
   3. Lifts with wide-belt type slings wherever possible.
   4. Do not use wire rope or ropes containing tar or other substances which might cause staining.
   5. If required, use wood rollers and provide cushion at end of wood slides.

1.7 WARRANTY

A. General Description: In addition to manufacturer's warranties, warrant Work for a period of one year from Date of Final Completion against defects in materials and workmanship.

B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in materials and workmanship.

C. Exceptions: Contractor shall not be held responsible for failures due to normal wear, neglect by Owner, vandalism and other causes outside the Contractor's control.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS (Number and Types Will Vary)

A. Café Chair
   1. Vestre – http://www.vestre.com.
   2. Or equivalent and accepted substitute.

B. Café Table

1. Landsacpeforms – http://www.landscapeforms.com.
2. Or equivalent and accepted substitute.

C. Lounge Chair
1. Vestre – http://www.vestre.com.
2. Or equivalent and accepted substitute.

D. Low Coffee Table
1. Bludot – http://www.bludot.com.
2. Or equivalent and accepted substitute.

E. Trash and Recycling Receptacles
1. Vestre – http://www.vestre.com.
2. Or equivalent and accepted substitute.

F. Tree Grate
1. Urban Accessories - https://urbanaccessories.com/
2. Or equivalent and accepted substitute.

G. Skate Deterrent
1. Grind To A Halt– www.grindtoahalt.com.
   a. Model: Cylinder GrinderMinder
   b. Finish: Stainless steel with brushed finish
2. Or equivalent and accepted substitute.

2.2 MANUFACTURED UNITS (Number and Types Will Vary)

A. Café Chair:
1. Type: Munch Café Chair
2. Finish: Powdercoat
3. Color: TBD
4. Quantity: 30

B. Café Table:
1. Type: 45” DIA Round Dining Table
2. Finish: Powdercoat
3. Color: TBD
4. Quantity: 6

C. Lounge Chair:
1. Type: Munch Lounge Chair
2. Finish: Powdercoat
3. Color: TBD
4. Quantity: 8

D. Low Coffee Table:
   1. Type: Circula Small Coffee Table
   2. Finish: Powdercoat
   3. Color: TBD
   4. Quantity: 2

E. Trash and Recycling Receptacles:
   1. Type: BLOC
   2. Finish: Powdercoat
   3. Color: TBD
   4. Quantity: 4

F. Tree Grate:
   1. Type: Jamison
   2. Material: Recycled Aluminum
   3. Finish: Brushed Finish
   4. Size: per drawings

G. Skate Deterrent:
   1. Model: Cylinder GrinderMinder
   2. Material: Stainless steel
   3. Finish: Brushed Finish
   4. Quantity: per drawings

PART 3 — EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.

B. Notification of Unsuitable Conditions: Before proceeding with Work, notify Owner and Owner's representative in writing of unsuitable conditions.

3.2 PREPARATION

A. Protection:
   1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
   2. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.

3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
4. Submit written notification of conditions damaged during construction to the Owner and Owner's representative within 2 working days of observed damage and before damage is covered.

3.4 INSTALLATION

A. General:
   1. Install as indicated on Drawings and per manufacturer's directions.

3.5 FIELD QUALITY CONTROL

A. Field Observation Reviews by Owner's representative: Coordinate and schedule with Owner's representative.

3.6 CLEANING

A. General: Clean and keep clean until Owner accepts maintenance.

B. Furniture Cleaning Method: Meet requirements of manufacturer's current printed instructions

3.7 PROTECTION

A. Furniture Storage: Protect furniture from damage due to construction Work operations and vandalism by storing in secure interior storage room until day of final review.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes decorative, metallic-coated tubular steel fences, gates framework, hardware and accessories; excavation and concrete foundation for posts and gate center drops.

B. Related Sections:

1. Section 03 30 00 – Cast in Place Concrete

1.2 REFERENCES

A. ASTM International:

1. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

2. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

3. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

4. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

B. Builders Hardware Manufacturers Association (BHMA):

1. BHMA A156.1 – Butts and Hinges.

2. BHMA A156.3 – Exit Devices.

3. BHMA A156.5 – Cylinders and Input Devices for Locks.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on fencing components, finishes, accessories, fittings and hardware.

C Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

D. Samples: Submit samples of 12 inch minimum length representing linear materials, illustrating construction and colored finish.

E. Closeout: Furnish maintenance data for hardware.

1.4 PERFORMANCE REQUIREMENTS

A. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial application class under ASTM F2408.

1.5 QUALITY ASSURANCE

A. Manufacturer and Installer: Companies specializing in manufacturing or installing Products specified in this section with minimum three years' experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver fence components in packed cartons or firmly tied rolls. Check to ensure that no damage has occurred during shipping or handling.

C. Identify each package with manufacturer's name.

D. Store fence materials in a secure and dry place.

1.7 WARRANTY

A. General: Warranties shall pay for all costs associated with repairs and replacement upon notification of defects.

B. Material Warranty: Provide material manufacturer's product warranty for a minimum of five (5) years from date of Substantial Completion for defective components, and a minimum of twenty (20) years from date of Substantial Completion for defective material finish, including cracking, chipping, peeling, blistering or corroding.

PART 2 – PRODUCTS

2.1 DECORATIVE METAL FENCES AND GATES

A. Manufacturers: Furnish compliant product of the following or approved equal.

1. Ameristar Perimeter Security.

B. System Description: ASTM F2408 decorative fence made from steel tubing or formed steel sheet. Two-rail style, with extended, flat-topped pickets, with matching swing gate. Basis of Specification: Ameristar Perimeter Security's "Montage II" in "Genesis" style.

1. Fence Height: Six (6) feet.

2. Post Spacing: As indicated on Drawings to maximum of eight (8) feet.

2.2 MATERIALS

A. Post and Panel Steel: ASTM A653, welded construction, minimum yield strength of 45,000 psi and G-90 hot dip galvanized coating.

B. Concrete: ASTM C94, Option A; Normal Portland Cement, 2,500 psi strength at 28 days. Furnish compliant type specified in Section 03 30 00.

2.3 COMPONENTS

A. Posts: 2-1/2 inches square, 12 gauge.

B. Pickets: 1-inch square tubes, 14 gauge tubing. Terminate with galvanized steel caps.

C. Rails: Steel tube or channel, minimum 1-1/2 inch x 1-1/2 inch, 14 gauge with picket holes spaced between 4 and 5 inches.

D. Gate Posts: Match fence posts for gates up to 4 feet in width and over 6 feet in height.

E. Panel to Post Brackets: Manufacturer's standard, tamperproof, corrosion-resistant steel, color-coated to suit post size and spacing, and compatible fastener hardware.

F. Post Caps: Formed from steel sheet and hot-dip galvanized after forming.

G. Interior surface of tubes formed from uncoated steel sheet shall be either hot-dip zinc coated same as exterior, or coated with zinc-rich thermosetting coating to comply with ASTM F2408.

H. Galvanizing: For components indicated to be galvanized and for which galvanized coating is not specified in ASTM F2408, hot-dip galvanize to comply with ASTM A123. For hardware items, hot-dip galvanize to comply with ASTM A153.

2.4 PEDESTRIAN SWING GATES

A. General: Single-leaf. Swing gates in direction shown on drawings.

1. Gate Height and Width: As indicated to maximum 48 inch width.

B. Factory-assemble gates utilizing manufacturer's matching decorative fence material.

C. Gate Ends: 2 inch square, 12 gauge.

D. Hardware: Hardware shall be furnished by fencing manufacturer. Gates shall be locking, self-closing and ADA compliant for operating force, with panic-style exit device.

1. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.

2. Exit Hardware: BHMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.

3. Rim Locks: BHMA A156.5, Grade 1, suitable for exterior use.

a. Function: 621 - Latchbolt by key from outside and by turn from inside. Latchbolt is held retracted by device from inside.

2.5 FABRICATION

A. Pre-cut all pickets, rails and posts to specified lengths. Pre-punch rails to accept pickets.

B. Insure correct alignment of pickets once installed through panel and gate rails and weld to rails for a rigid panel assembly.

C. Join all gate rail and upright intersections by welding.

2.6 COATING MATERIALS

A. Finish all assembled panels, posts and gates with manufacturer's standard, 2 mil thick, epoxy primer and acrylic topcoat meeting specified performance requirements. Color: Standard Black..

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas scheduled to receive decorative metal fencing for conditions that will adversely affect execution, performance, or quality of work.

B. Do not start work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Stake out locations of fence lines, posts and gates. Indicate locations of utilities and underground structures. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade.

B. Verify elevation of finish grade and establish indicated fence heights above finish grade.

3.3 INSTALLATION

A. Install fences according to manufacturer's written instructions.

B. Fence panels shall be attached to posts with brackets supplied by the manufacturer.

C. Set posts in concrete footings as shown and specified. Set plumb, true to line and layout; temporarily brace as required. Crown top of post concrete footings to shed water away from the posts. Set base of crown level with surrounding asphalt or concrete, and 6 inches below grade at soil.

1. Footing Depth: 3'-0" minimum.

2. Footing Diameter: Four times post diameter.

D. 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. Use manufacturer's 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. Do not use products of other manufacturers.

E. Gates:

1. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.

2. Install hardware per manufacturer's instructions, using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary.

3.4 ERECTION TOLERANCES

A. Division 1 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch

C. Maximum Offset From Indicated Position: 1 inch

D. Minimum distance from property lines: 6 inches.

3.5 CLEANING

A. Scatter post-hole excavations uniformly, away from posts.

END OF SECTION

PART 1 — GENERAL

1.1 SUMMARY

A. Provide all products and execute all labor to achieve installation of the irrigation system complete as indicated by the Drawings and Specifications.

B. For Landscape Maintenance Period, see Section 32 01 00.

C. For Soil Preparation and Soil Mixes, see Section 32 91 13.

D. For Planting Area Finish Grading, see Section 32 91 19.

E. For Grasses, see Section 32 92 00.

F. For Plant Material, see 32 93 00.

G. Other Related Work: Consult all other relevant Specification Sections to determine the extent and character of work specified elsewhere, but related to that included herein.

1.2 DEFINITIONS

A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of Owner’s representative in writing.

1.3 REFERENCES

A. DIV — Division of Industrial Safety.

B. UPC — Uniform Plumbing Code published by the Association of Western Plumbing Officials. Most current edition.

C. ASTM — American Society for Testing and Materials.

D. NSF — National Sanitation Foundation.

1.4 SUBMITTALS

A. Product data: Prior to delivery to site, submit 5 copies of current manufacturer’s specifications and catalog cuts for the complete list of materials and assemblies to be installed.

B. Final Record Documents: Submit Final Record Documents to the Owner’s representative at Preliminary Review.

C. Test Reports

1. Analyses: Samples of materials may be taken and analyzed for conformity to specification at any time. The Contractor shall furnish samples as requested.

2. Rejected Materials: Contractor shall remove rejected materials immediately from the site.
3. Cost of Testing: The Contractor shall pay cost of testing of materials not meeting specifications.
4. Hydrostatic Testing Review
   a. Time of Review: The Owner's representative will review the completed irrigation work during the hydrostatic testing prior to the backfilling of the trenches.
   b. Notification of Review: Notify the Owner's representative and University Sprinkler Specialist (723-4995) at least 72 hours prior to the anticipated review.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Laws, Codes and Regulations: Perform work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work.
   2. Inspections and Permits: Provide for all inspections and permits required by federal, state and local authorities in furnishing, transporting and installing materials.
   3. Traffic Control: It is the responsibility of the contractor to ensure adequate protection and controls for pedestrian and vehicular traffic in the vicinity of the project areas. The contractor shall provide all signs, barricades, flagmen, etc., necessary to meet all traffic requirements for this project at his own expense.

1.6 RECORD DOCUMENTS

A. Progress Record Documents:
   1. Maintain on the construction site at all times a record of all materials and equipment installed each day.
   2. Daily record information neatly to scale, on full-size prints of the irrigation construction documents.
   3. Record information neatly to scale, on full-size prints of the irrigation construction documents.
   4. Information shall include all changes, substitutions, and manufacturer's names and catalogue members for materials and equipment. Show actual locations of all valves and irrigation piping. Show dimensions from easily-identifiable permanent structures such as walls, curbs, fences, buildings or walks.

B. Final Record Documents:
   1. Transfer all information noted on Progress Record Documents.
   2. After Work completion, transfer information noted on prints. Submit Progress Record Documents to the Owner's representative for review of general information content (Owner's representative will not be responsible for errors or omissions).
   3. Contractor shall be responsible for accuracy of information and errors or omissions.
   4. If first submittal is not accepted by Owner's representative, resubmit until accepted.
   5. Once accepted, submit accepted final Record Documents to Owner

1.7 SERVICE MANUALS

A. Submittal Procedure: At Preliminary Review, submit five individually bound Service Manuals to the Owner's representative.

B. Content:
   1. Complete drawings, diagrams and spare parts lists of all equipment installed showing components and catalog numbers together with the manufacturer's name and address.
   2. Index sheet indicating the Contractor's name, address and telephone number.
   3. Copies of equipment, warranties and certificates.
   4. Complete operating and maintenance instructions in sufficient detail to permit operating personnel to understand, operate, and maintain all equipment.

1.8 INTENT OF DRAWING AND SPECIFICATIONS

A. It is the intent of the Drawings and Specifications to provide a complete operable irrigation system. Any items not specifically shown in the Drawings or called for in the Specifications, but which are normally required to conform with such intent, are to be considered as part of the work.

1.9 SUBSTITUTIONS

A. Written Acceptance: Specific reference to manufacturer's names and products specified in these sections are used as standards; this implies no right to substitute other materials or methods without written acceptance of the Owner's representative.

B. Contractor's Responsibility: Installations of accepted substitution(s) must be made to the satisfaction of Owner's representative and without additional cost to Owner.

1.10 REVIEW OF SITE

A. Visit project site and review conditions as they exist prior to submitting bid.

1.11 WORK SCHEDULE

A. Submit a proposed work schedule to the Owner's representative for acceptance at least fourteen days prior to start of irrigation work. Submit revised schedule(s) to the Owner's representative immediately.

1.12 COORDINATION

A. Coordinate and cooperate with other contractors to enable the work to proceed as rapidly and efficiently as possible in a workmanlike manner.

1.13 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Labeling: Furnish standard products in unopened manufacturer's standard containers bearing original labels showing quantity, analysis and name of manufacturer.

B. Storage: Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product. Protect PVC pipes and fittings from direct sunlight. Beds on which pipe is stored must be full length of pipe.

1.14 SITE CONDITIONS

A. Existing Condition

1. General: The Contractor shall use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the work.
2. Barriers: Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
3. Operations: Do not store materials or equipment, permit burning, or operate or park equipment under the drip line of existing plants to remain.
4. Notification of Damages: Submit written notification of all conditions damaged during construction to the Owner and Owner's representative immediately.
5. Determination of Damage: Owner's representative will determine the extent of damage and value of damaged plant material.
6. Replacement of existing plant material: Replace existing plants to remain which are damaged during construction with plants of the same species and size as those damaged at no cost to the Owner.
7. Replacement of Existing Irrigation System: Immediately repair damage to existing systems. After making repairs remove all heads in repaired circuit(s) and flush lines clear of all dirt and foreign matter. After cleaning lines replace heads and return system to operating status.

1.15 PRELIMINARY ACCEPTANCE, FINAL ACCEPTANCE AND COMMENCEMENT OF THE MAINTENANCE PERIOD

A. For Landscape Maintenance Period, see Section 32 01 00.

1.16 WARRANTY

A. In addition to manufacturer's guarantees or warranties, work shall be warranted for 1 year from the date of Final Acceptance against defects in material, equipment and workmanship. Warranty shall also cover repair of damage to any part of the premises resulting from leaks or other defects in materials, equipment, and workmanship to the satisfaction of the Owner.

1.17 WARRANTY FOR SPRINKLER IRRIGATION SYSTEM

A. Include the following warranty on contractor's letterhead with service manuals:

1. WE HEREBY WARRANT THAT THE SPRINKLER 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 NEGLECT ARE ACCEPTED. 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.: _____

TELEPHONE: _____

GUARANTEE TO: _____

_____

_____

DATE OF ACCEPTANCE: _____

AUTHORIZED REPRESENTATIVE: _____

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERES

2.2 WATER METER

A. Refer to Civil Section.

2.3 IRRIGATION BACKFLOW PREVENTER

A. As shown on the Drawings.

2.4 PIPE

A. General: All pipe shall be NSF approved.

B. Piping on Pressure Side of Control Valves:
1. One and one half inches and Smaller: ASTM D 1785 polyvinyl chloride (PVC) 1120-1220, Schedule 40.

C. Piping on Non-pressure Side of Control Valves:
1. ASTM D 2241 polyvinyl chloride (PVC) 1120-1220, SDR 21.0, Class 200.
2. ASTM D 2287 flexible PVC hose.

2.5 FITTINGS

A. Fittings for Pressurized Solvent-Welded Pipe:
1. Connections of ASTM D 2466 and ASTM D 1869 Class 200 PVC as provided by the same manufacturer as the pipe.
2. Connections of Mains to Remote Control and Quick-coupling Valves: ASTM D 2467 Schedule 80 PVC solvent-weld socket fittings.

B. Fittings for Non-Pressurized Solvent-Welded Pipe:
1. ASTM D 2466 and ASTM D 2467 Schedule 40 and Schedule 80, polyvinyl chloride, standard weight, as manufactured by “Sloane,” “Lasco,” or accepted substitute. Refer to installation details.
2. Threaded PVC Nipples: Schedule 80 PVC.

2.6 NIPPLES

A. Non-Ferrous: Schedule 40 red brass (85% copper, 15% zinc) with MIPT at both ends; ASTM B43.

B. Plastic: Schedule 80, Type I, Grade 1 polyvinyl chloride (PVC); threaded both ends; ASTM D1784 and D1785; uniformly grey in color.

C. Flexible: Factory made and assembled consisting of flexible polyvinyl chloride (PVC) hose fitted at each end with Schedule 40 PVC male adaptors; test rated at 200 psi static.

2.7 SLEEVE FOR CONTROL WIRE AND WATER LINE

A. PVC 1120-1220, Schedule 40 pipe.

2.8 IRRIGATION CONTROLLER

A. As shown on the Drawings.

2.9 REMOTE CONTROL VALVES

A. As shown on the Drawings.

2.10 CONTROL WIRE

A. As shown on the Drawings.

B. Splicing Materials: Aqua Splice Heat Shrink Splice as manufactured by Raychem or 3M DBY.

C. Communications and sensor cable: As required by Controller Manufacturer.

2.11 VALVE BOXES FOR REMOTE CONTROL VALVES IN PLANTING AREAS

A. Model No.: 1419B-12B.

B. Color of Box and Lid: As shown on Drawings.

C. Manufacturer: Carson Industries Inc., 1925 “A” Street, La Verne, Calif., 91750, (714) 596-1988.

2.12 VALVE BOXES FOR QUICK COUPLING VALVES IN PLANTING AREAS

A. Model No.: 910-12B.

B. Color of Box and Lid: As shown on Drawings.

C. Manufacturer: Carson Industries Inc., 1925 “A” Street, La Verne, Calif., 91750, (714) 596-1988.

2.13 VALVE BOXES

A. For Remote Control Valves:

1. Planted Areas: Injection-moulded of Polyesters and fibrous inorganic temperature resistant components. Box shall provide adequate clearance to operate and service valve. Box and lid to be black, as manufactured by “Ametek”, “Christy” or accepted equal.

2.14 QUICK-COUPLING VALVES

A. Valve and Key: As specified on Drawings.

B. Furnish 2 valve keys fitted with 3/4" swivel hose cells.

2.15 STEEL STAKES AND PIPE CLAMPS

A. As shown on Drawings.

PART 3 — EXECUTION

3.1 LAYOUT

A. General: During installation, conform as closely as possible to Drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown.

B. Coverage: Make any necessary minor adjustments to layout required to achieve full coverage of irrigated areas at no additional cost to Owner.

C. Stubouts: Where connections to existing stubouts are required, make necessary adjustments should stubouts be located differently than shown on the Drawings.

D. Piping: Where piping is shown to be under paved areas but running parallel and adjacent to planted area, install piping in planted areas, unless specifically noted to be installed under paved areas. Do not install directly over another line in same trench.

E. Existing Irrigation System: Adjust new head layout as necessary where it abuts existing irrigation systems.

3.2 TRENCHING

A. Trench Depths:

1. 18-inch deep over pipe on pressure side of irrigation control valve, control wires and quick coupling valves.
2. 12-inch deep on non pressure side of irrigation control valve.

B. Trench Slopes:

1. Mains: Slope to drain to control valves.
2. Laterals: Slope to or from control valves.

3.3 CONDUITS AND SLEEVES

A. Conduit: Furnish and install conduit where control wires pass under or through structures or paving. Conduits to be of adequate size to accommodate retrieval for repair of wiring and shall extend 12 inches beyond edges of walls.

B. Sleeving: Install sleeves for all pipes passing through or under structures or paving as shown on Drawings. Sleeving to be of adequate size to accommodate retrieval of wiring or piping for repair and shall extend 12 inches beyond edges of paving or other structures.

3.4 PIPE LINE ASSEMBLY

A. General:
1. Install pipes and fittings in accordance with manufacturer's latest printed instructions.
2. Clean all pipes and fitting of dirt, scales and moisture before assembly.
3. Install pipe fittings with at least 2 inches clearance from other pipes or fittings.

B. Solvent-Welded Joints for PVC Pipes:
1. Use solvents and methods specified by pipe manufacturer.
2. Let solvents cure a minimum of 1 hour before applying any external stress on the piping and at least 24 hours before placing the joint under water pressure.

C. Threaded Joints for Swing Joints:
1. Use Teflon tape on threaded PVC fittings for swing joints only.
2. Use strap-type friction wrench only. Do not use metal-jawed wrench.

D. Laying of Pipe:
1. Remove from trench all rocks or clods 1 inch diameter or larger. Bed pipes in at least 2 inches of soil excavated from trench. Backfill on all sides of piping to provide a uniform bearing.
2. Snake pipe from side to side of trench bottom to allow for expansion and contraction. One additional foot per 100 ft. of pipe is the minimum allowance for snaking.
3. Do not lay PVC pipe when there is water in the trench.

3.5 IRRIGATION CONTROL VALVES

A. Valve Locations: Install control valves where shown on Drawings and group together where practical.

B. Valve Box Locations: Where two or more valves are installed adjacent to each other, provide at least 6 inches separation between valve boxes and align boxes parallel to each other in a row.

C. Valve Boxes: Install valve boxes over valves to be flush with accepted finish grade.

3.6 SPRINKLER HEADS

A. Spray and Bubbler Heads: Install all spray and bubbler sprinklers on a swing joint assembly as detailed on the Drawings.

3.7 QUICK COUPLING VALVES

A. Install on a swing joint assembly as detailed on the drawings.

3.8 AUTOMATIC CONTROLLER

A. General: Install per local code and manufacturer's latest printed instructions.

B. Connection to Valves: Connect remote valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.

C. Labeling: Affix controller name (i.e., "Controller A") on inside of controller cabinet door with minimum of 1 inch high permanent letters.

D. Irrigation Diagram: Affix a non fading copy of irrigation diagram to cabinet door below controller name. Irrigation diagram to be sealed between two plastic sheets 20 mil. minimum thickness. Irrigation diagram shall be a reduced copy of the Record Drawing, clearly showing all valves operated by the controller, station number, valve size, and type of planting irrigated.

E. Grounding and Certification: Per Manufacturers specifications and requirements.

3.9 CONTROL WIRING

A. Placement: Install control wires in common trenches with sprinkler mains and laterals wherever possible. Lay to the bottom side of pipe line. Provide a minimum of 3 feet of looped slack at valves. Snake wires in trench to allow for contraction of wires. Tie wires in bundles at ten 10-foot intervals.

B. Spare: Install one unconnected spare control wire running from the controller through each intermediate control valve box and label at controller.

C. Size: Control wire: 14 AWG. Common wire: 12 AWG.

D. Color Codes: Color code control wires as follows:

1. Common wire, white.
2. Control wire, black.
3. Extra wire, orange.
4. Detection wire, yellow.

E. Detection Wire: Install a AWG size #12 or greater wire on top of the PVC supply line for the purpose of possible future mine detection search as the control wires are being installed on the bottom for the PVC supply line with electrical tape every 10 feet.

F. Splicing: Crimp control wire splices at remote control valves. Seal with specified splicing materials. Line splices will be allowed only on runs of more than 2,500 feet.

3.10 CLOSING OF PIPE AND FLUSHING OF LINES

A. Capping: Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.

B. Flushing: Thoroughly flush out all water lines before installing heads, valves and other hydrants.

C. Testing: Test as specified below. Upon completion of testing, complete assembly and adjust sprinkler heads for proper water distribution.

3.11 HYDROSTATIC TESTING

A. Procedure: Make hydrostatic tests with risers capped when welded PVC joints have cured at least 24 hours. Center load piping with backfill to prevent pipe from moving under pressure. All couplings and fitting shall be exposed. Apply continuous static water pressure of 125 psi as follows:

1. All Piping on the Pressure Side of Control Valves: Four hour test.

2. All Piping on the Non pressure Side of Control Valves: Two hour test.

B. Leaks and Retest: Repair leaks observed from tests and repeat testing until system passes tests.

3.12 BACKFILLING AND COMPACTING

A. Backfill Material at Planting Areas:

1. After system is operating and required tests and reviews have been made, backfill excavations and trenches with clean sand and soil, free of debris.

2. Backfill in 6-inch lifts with compaction performed between each lift.

B. Backfill Material at Unsleeved Pipe Under Paving: Provide all PVC pipe under paving with minimum of 4 inches of sand backfill on all sides and 30 inches cover to bottom of paving.

C. Backfill Material at Existing Underground Pipes: Use only backfill material which has been screened to eliminate all material larger than 3/8 inches when backfilling adjacent to existing underground pipe lines.

D. Backfill Compaction:

1. Regardless of the type of pipe covered, compact to minimum 95% density under pavements, and 85% in planted areas.

2. Compact trenches in areas to be planted by thoroughly flooding or jetting.

3. Compact trenches in paved areas in 6-inch lifts.

E. Finish Grading: Dress off all areas to accepted finish grades. Refer to Section 02260 Planting Area Finish Grading

3.13 CLEAN-UP

A. Daily: Keep all areas of work clean, neat and orderly at all times.

B. Final: Clean up and remove all deleterious materials and debris from the entire work area prior to Final Review.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Subsoil Ripping of Planting Areas.
   2. Mixing and Placement of Import Soil Mix.
   3. Mixing and Placement of Planter Soils.

B. For Earthwork, see Division 31.

C. For Landscape Maintenance Period, see Section 32 01 00.

D. For Irrigation, see Section 32 84 00.

E. For Planting Area Finish Grading, see Section 32 91 19.

F. For Plant Material, see Section 32 93 00.

1.2 DEFINITIONS

A. Acceptance: Wherever the terms “acceptance” or “accepted” are used herein, they mean acceptance of Owner’s representative in writing.

1.3 ALLOWANCE

A. Allowance for Backfill Mixes and Soil Amendment Programs:
   1. Provide cash allowance based on materials specified assuming new materials are purchased and installed.

B. Prior to purchase of materials, after final backfill mixes and amendment programs have been accepted by Owner’s representative, submit complete documentation of labor, materials and equipment comparing allowance with proposed installed costs of final mixes and amendment program.

C. Credit unused monies to Owner.

1.4 REFERENCES

A. ASTN – ASTM International
   1. D 1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. Most current edition.
   2. C 136 – Test Method for Sieve Analysis of Fine and Coarse Aggregates. Most current edition.
   3. D854 – Test Method for Specific Gravity Soils. Most current edition.
   4. D2974 – Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils. Most current edition.

5. D3665 - Practice for Random Sampling of Construction Materials. Most current edition.
6. D4427 – Classification of Peat Samples by Laboratory Testing. Most current edition.

B. USDA – United States Department of Agriculture:
   1. Soil Texture Triangle Classification. Most current edition.
   2. Handbook No. 60. Most current edition.

C. ASA – American Society of America.

D. SSSA - Soil Science of America.

E. UC – University of California.

F. Geotechnical Investigation Report: Geotechnical Investigation Report by A3GEO, dated June 10, 2013.

1.5 SUBMITTAL

A. Product Data:
   1. Planter Soil.
   2. Imported Soil.
   3. Organic compost.

B. Test Reports:
   1. Provide a “Complete Standard Analysis” of imported and planter soils and organic compost indicating the following:
      a. pH measurement in the Saturation Extract, Electrical Conductivity of the saturation extract and Sodium Adsorption Ration of the saturation extract. Utilize the following procedures utilizing the Methods of the United States Salinity Laboratory as published in the Agricultural Handbook Number 60 entitled “Diagnosis and Improvement of Saline and Alkali Soils”:
         (a) pH Method 21
         (b) Saturation Extract Method 2
         (c) Sodium Adsorption Ratio Method 20b
         (d) As determined by ammonium bicarbonate-DTPA: Methods of Soil Analysis, Part 1, Physical and Mineralogical Methods, Soil Science Society of America, Inc., 1986, identify the following nutrients and elements:
         (e) Boron, calcium, copper, iron, magnesium, manganese, molybdenum, phosphorous, potassium, sodium, sulfur, and zinc.
         (f) Analyze the saturation extract for calcium, magnesium, sodium, boron, chloride, phosphorus, nitrate and sulfate.
      b. Measure the following trace metals by the ammonium bicarbonate-DTPA extract: Methods of Soil Analysis, Part 1, Physical and Mineralogical Methods, Soil Science Society of America, Inc., 1986.
         (a) Aluminum, arsenic, cadmium, chromium, cobalt, lithium nickel, selenium, silver, strontium, tin and vanadium.
      c. Determine the presence of calcium carbonate and/or magnesium carbonate.

d. As determined by Methods of Soil Analysis, Part 3 Chemical Methods, Soil Science Society of America, Inc., 1996, identify Soil Texture (gravel, sand, silt and clay) and percent gravel.
e. As determined by Methods of Soil Analysis, Part 3 Chemical Methods, Soil Science Society of America, Inc., 1996, identify organic matter content by the measurement of organic carbon. The quality of organic matter shall be determined by measuring organic carbon and total nitrogen.
f. As determined by Method 34b of Agricultural Handbook Number 60, identify Water Infiltration Rate.
g. Interpretation of nutritional deficiencies or excesses and potential toxicities shall be given.
h. Define import soil source and organic matter locations.
   (a) Provide copy of the planting plan with each composite sample keyed by number to the area from which the composite samples were taken.
i. Soil Test for Parasitic Nematodes (if required).
j. Soil Test for Herbicide Contamination (if required).
k. Samples shall include location of source material, date of samples, and project name.
l. Bulk density and particle size analysis, including the following gradient of mineral content (USDA Designation is size in mm)
   (a) Gravel – over 2mm
   (b) Sand – 0.05 – 2mm
   (c) Silt – 0.002-0.05mm
   (d) Clay – minus 0.002mm
m. Sieve Analysis performed and compared with USDA Soil Classification System. Sieve analysis shall be by a combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in accord with particle size analysis, Chapter 15, Methods of Soil Analysis, Part 1, SSSA-ASA, Inc., 1986.

2. Provide a percent pore space analysis as follows:
   a. 1 minus [rock specific gravity unit divided by the bulk specific gravity] times

1.6 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
   2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.

B. Contractor Qualifications:
   1. Have successfully installed structural soil mixes similar to the quality specified for a period of not less than 5 years.
   2. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

1.7 SITE CONDITIONS

A. Environmental Requirements:
   1. Do not work soil 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.
   2. Apply water, if necessary, to bring soil to an optimum moisture content for tilling.
   3. Do not work soil when muddy or frozen.
   4. Do not apply chemicals if wind conditions will cause hazardous drift to people or property.

B. Existing Conditions:
   1. Prior to Work commencement review locations of existing public underground utilities and structures with appropriate utility companies and clearly mark in field.
   2. Prior to Work commencement review location of existing private underground utilities and structures with Owner and clearly mark in field.
   3. Prior to Work commencement and after reviewing the Owner's record irrigation documents, review and clearly mark in field heads, valve boxes and other underground equipment, materials, and structures.

1.8 PROJECT CONDITIONS

A. Areas to receive structural soils shall be inspected by Owner's Representative before starting work.

B. Verify extent of work requirements, including but not limited to potential need for temporary storage and staging of soils, including moving soil stockpiles at site to accommodate other work and the need to protect installed soils from compaction, erosion and contamination.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

A. Pre-Plant Fertilizer for On-Grade Planting Areas:
   1. Gro-Power, Inc. – http://www.gropower.com.
   2. Or equivalent and accepted substitute.

B. Other Commercial Fertilizers:
   1. Or equivalent and accepted substitute.

C. Planter Soil:
   1. American Soil and Stone – http://www.americansoil.com.
   2. Or equivalent and accepted substitute.

D. Imported Soil
   1. American Soil and Stone – http://www.americansoil.com.
   2. Or equivalent and accepted substitute.

E. Soil Testing Agency:
   1. Wallace Laboratories – http://us.wlabs.com.
   2. Or equivalent and accepted substitute.

F. Geotextile Fabric
   1. Carthage Mills – http://carthagemills.com.
   2. TenCate Nicolon Corporation – http://www.tencate.com.
   3. Or equivalent and accepted substitute.

2.2 MATERIALS

A. Planter Soil:
   1. American Soil and Stone "Ultra Bedding Mix”.
   2. Or equivalent and accepted substitute.
   3. Soil shall be of uniform quality and free of phytotoxic compounds.
   4. Particle Size Analysis: Less than 80-percent and more than 60-percent sand; less than 40-percent silt; less than 20-percent clay.
   5. pH: Range 5.5 – 7.5.
   6. EC: Less than 2.0 ds/m (USDA Circular No. 982).
   7. SAR: Less than 6.0.
   8. Contaminants: Free of phytotoxic compounds and debris, seeds or rhizomes of noxious weeds, herbicides, pesticides, heavy metals, biological toxins, excesses of fertilizer, component toxic to plants or humans, and less than 2-percent gravel.
   9. Salts: The electrical conductivity of the soil shall not exceed 2.-0 decisemens per meter as determined by the saturated-soil test method described in USDA Circular No. 982. The sodium absorption ratio shall not exceed 6.0. Boron levels shall not exceed 1.0 ppm.
   10. Boron: Less than 1.0 ppm.
   11. Sodium: Less than 5.0 meq/1.
   12. Chloride: Less than 5.0 meq/1.

B. Imported Soil:
   1. American Soil and Stone “General Landscape Soil”.
   2. Or equivalent and accepted substitute.
   3. Soil shall be of uniform quality and free of phytotoxic compounds.
   4. Particle Size Analysis: Less than 80-percent and more than 60-percent sand; less than 40-percent silt; less than 20-percent clay.
   5. pH: Range 5.5 – 7.5.
   6. EC: Less than 2.0 ds/m (USDA Circular No. 982).
   7. SAR: Less than 6.0.
   8. Contaminants: Free of phytotoxic compounds and debris, seeds or rhizomes of noxious weeds, herbicides, pesticides, heavy metals, biological toxins, excesses of fertilizer, component toxic to plants or humans, and less than 2-percent gravel.
   9. Salts: The electrical conductivity of the soil shall not exceed 2.-0 decisemens per meter as determined by the saturated-soil test method described in USDA Circular No. 982.

The sodium absorption ratio shall not exceed 6.0. Boron levels shall not exceed 1.0 ppm.

10. Boron: Less than 1.0 ppm.
11. Sodium: Less than 5.0 meq/1.
12. Chloride: Less than 5.0 meq/1.

C. Organic Compost:
   1. Fully composted aerobic compost without presence of decomposition products.
   2. Redwood and cedar products are not acceptable.
   3. Ash content of not less than 8 percent and no more than 50 percent.
   4. pH between 6 and 7.
   5. Salt content shall be less than 10 millimho / cm @ 25 degrees (ECe less than 10) in a saturated paste extract.
   6. Boron content of saturated extract <1.0 parts per million.
   7. Silicon content (acid-insoluble ash) shall be less than 20 percent.
   8. Calcium carbonate shall not be present

D. Potential Chemical Amendments Required by Accepted Amendment Programs and Backfill Mixes:
   1. Ground Limestone: Agricultural limestone containing not less than 85 percent of total carbonate, ground to such fineness that 50 percent will pass No. l sieve and 90 percent will pass No. 20 sieve
   2. Dolomite Lime: Agricultural grade mineral soil conditioner containing 35-percent minimum magnesium carbonate and 49-percent minimum calcium carbonate, 100 percent passing #65 sieve.
   3. Gypsum: Agricultural grade product containing 80-percent minimum calcium sulfate.
   4. Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20- to 30-percent iron and 35- to 40-percent sulfur.
   5. Potassium Sulfate: Agricultural grade (0-0-50).
   6. Single Superphosphate: Commercial product (0-20-0).
   7. Treble Superphosphate: Commercial product (0-48-0).
   8. Ammonium Nitrate: Commercial product (30-0-0).
   9. Calcium Nitrate: Agricultural grade containing 15.5-percent nitrogen.
   10. Urea Formaldehyde: Granular commercial product containing 38-percent nitrogen.
   11. IBDU (Iso Butyldiene Diurea): Commercial product containing 31-percent nitrogen.
   12. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96-percent sulfur.
   13. Iron Sequestrene: Geigy Iron Sequestrene 330 Fe
   14. Silicic Acid Calcium: Commercial grade.

E. Perlite:
   1. Horticultural Perlite, 6.5 to 7.5 pH.
   2. Or accepted substitute.

F. Volcanic Rock:

1. Clean, free of materials toxic to plant growth, 60 pounds per cubic foot (961 kilograms per cubic meter) maximum damp weight, size as specified.
2. Or accepted substitute.

G. Preplant Fertilizer for Trees, Shrubs, Ground Cover and Turf Areas:
1. Gro-Power Plus 5-3-1.
2. Or accepted substitute.

PART 3 — EXECUTION

3.1 EXAMINATION

A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
B. Underground Utilities and Structures: Verify that the locations of utilities, structures and other underground items have been clearly marked.
C. Notification of Unsuitable Conditions: Before proceeding with Work, notify Owner and Owner's representative in writing of unsuitable conditions and conflicts.

3.2 PREPARATION

A. Protection of Existing Conditions:
1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction
3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
4. Submit written notification of damaged plants and structures to Owner and Owner's representative immediately.
B. Surface Preparation:
1. Inspect soil surface for sticks, oils, chemicals, plaster, concrete, and other deleterious materials.
2. Do Work required to remove and dispose of the deleterious materials.

3.3 SOIL TESTS TO DETERMINE AMENDMENT PROGRAM

A. Provide samples to Wallace Laboratories for "Complete Standard Analysis" report and amendment recommendations.
B. At least 30 days prior to soil installation, submit written "Complete Standard Analysis" report, including amendment recommendations, to Owner's representative for determination of the final mixes and amendment program.

3.4 SOIL TESTS FOR NEMATODES AND HERBICIDE

A. Parasitic Nematodes:
1. Test soils which have been used for agricultural purposes within the prior 12 months for parasitic nematodes.

2. Soil will be acceptable if the parasitic nematode population is less than 200 per 50 cubic centimeters of soil.
3. Do not artificially dry soil prior to testing.
4. Submit written test report to the Owner and Owner's representative.

B. Herbicide Contamination:
1. Perform a radish/rye grass growth trial on soils suspected of herbicide contamination.
2. Submit written test report to the Owner's representative.

3.5 IMPORTED SOIL INSTALLATION

A. Scarification:
Immediately prior to imported soil placement, scarify existing soils at bottom and sides of planting pit.
B. Placement: Place mix carefully into pits avoiding damage or contamination of other Work.
C. Settlement Allowance: Place backfill mix to depth and elevation which allows for settlement.
D. Mock-Up: Mock-up areas of backfill mix at the specified depths and apply irrigation to induce settlement, if required to help determine the amount of settlement which will be caused by irrigation and rain.

3.6 PLANTER SOIL INSTALLATION

A. Placement: Place mix carefully avoiding damage or displacement of other materials such as waterproof membrane, protection board, drain rock, filter fabric, lightweight fill material and irrigation piping.
B. Compaction: Compact soil mix by thoroughly watering or jetting the entire planter.
C. Settlement: Fill settled low areas with soil mix and repeat compaction and filling process until settlement ceases

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for furnishing, placing, and compacting bioretention soil, drainage rock, perforated pipe, area drains, pop-up emitters, and cobblestone as indicated in plans.

1.2 REFERENCES

American Society for Testing and Materials (ASTM):

ASTM D422 –	Standard Test Method for Particle-Size Analysis of Soils
ASTM D1557 –	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
ASTM D2434 –	Standard Test Method for Permeability of Granular Soils (Constant Head)
ASTM D5268 –	Standard Specification for Topsoil Used for Landscaping Purposes

1.3 GENERAL REQUIREMENTS

A. 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.

B. Bioretention Soil shall be a mixture of topsoil or fine sand, and compost, measured on a volume basis.

Mix A – Topsoil Blend
10%-20% Topsoil
50%-60% Fine Sand
30%-40% Compost

Mix B – Fine Sand Blend
60%-70% Fine Sand
30%-40% Compost

1.4 SUBMITTALS

A. The contractor shall submit for approval:

1. A 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. 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.

4. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in Section 1.4.

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. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.

7. Provide the following information about the testing laboratory(ies) name of laboratory(ies) including:

   - Contact person(s)
   - Address(es)
   - Phone contact(s)
   - E-mail address(es)
   - Qualifications of laboratory(ies), and personnel including date of current certification by STA, ASTM, or approved equal

PART 2 - PRODUCTS

2.1 SAND FOR BIORETENTION SOIL

A. General

1. 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 size shall be non-plastic.

B. Sand for Bioretention Soil Texture.

1. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40, #30, #16, #8, #4, and 3/8 inch sieves (ASTM D 422 or as approved by the Engineer), and meet the following gradation:

Sieve Size	Percentage Passing (by weight)	
	Min	*Max*
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

Note all sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.

2.2 TOPSOIL FOR BIORETENTION SOIL

General: Topsoil shall be free of wood, waste, or any other deleterious material.

Topsoil for Bioretention Soil Texture: The overall topsoil texture shall be loamy sand as analyzed by an accredited laboratory. The overall dry weight percentages shall be 60-90% sand, with less than 20% passing than the #200 sieve and less than 5% clay of the total weight with no gravel.

2.3 COMPOSTED MATERIAL

A. Compost shall be a well decomposed, stable, weed free organic matter source 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).

B. Compost Quality Analysis Before delivery of the soil, the Contractor 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 Evaluation of Composting and Compost (TMECC). The lab report shall verify:

1. Feedstock Materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.

2. Organic Matter Content: 35% - 75% by dry wt.

3. Carbon and Nitrogen Ratio: C:N < 25:1.

4. Maturity/Stability: 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 (120F) upon delivery or rewetting is not acceptable. In addition, any one of the following is required to indicate stability:

   a. Oxygen Test < 1.3 O2 /unit TS /hr
   b. Specific oxy. Test < 1.5 O2 / unit BVS
   c. Respiration test < 8 C / unit VS / day
   d. Dewar test < 20 Temp. rise (°C)
   e. Solvita® > 5 Index value

5. Toxicity: any one of the following measures is sufficient to indicate non-toxicity.

   a. NH4- : NO3-N < 3
   b. Ammonium < 500 ppm, dry basis
   c. Seed Germination > 80 % of control
   d. Plant Trials > 80% of control
   e. Solvita® > 5 Index value

6. Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.

   a. Total Nitrogen content 0.9% or above preferred.
   b. Boron: Total shall be <80 ppm; Soluble shall be <2.5 ppm

7. Salinity: Must be reported; < 6.0 mmhos/cm

8. pH shall be between 6.5 and 8. May vary with plant species.

    a. Particle size: 95% passing a 1/2” screen.

C. Bulk density: shall be between 500 and 1100 dry lbs/cubic yard

D. Moisture Content shall be between 30% - 55% of dry solids

E. Inerts: compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1 % by weight or volume

F. 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.

G. Select Pathogens: Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <10000 MPN/gram

H. Trace Contaminants Metals (Lead, Mercury, Etc.) Product must meet US EPA, 40 CFR 503 regulations

I. Compost Testing. The Contractor 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 Contractor will pay for the test.

2.4 PERMEABLE AGGREGATE BASE ROCK

Aggregate base shall be permeable Class 2, 3/4" maximum. When the aggregate base is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of

construction to prevent water from collecting or standing on the area to be covered with aggregate base.

2.5 COBBLESTONE:

3-inch to 6-inch diameter water-worn stone ("Lodi" or Engineer approved equal). Cobblestone to be rounded with no sharp grade breaks. Cobbles with breaks or fractures are not allowed

2.6 AREA DRAINS

Area Drain. 4" Round Atrium Grate, Green. HDPE. Open surface area shall be 17 sq.in. minimum.

2.7 Pop-up Emitters

NDS polypropylene (size per plan), green, or as approved by the Engineer

2.8 High Density Polyethylene Pipe (HDPE)

1. Perforated Pipe: HDPE Perforated pipe conforming to ASTM D3212, or ASTM 1417. Perforations shall be 2 rows of ½" holes on 5" centers, 120° apart.

PART 3 - EXECUTION

3.1 PLACEMENT AND COMPACTION OF BIORETENTION SOILS

Place the bioretention soil in 8" to 12" lifts. Lifts are not to be compacted but are placed to reduce the possibility of excessive settlement. Allow time for natural compaction and settlement prior to planting. Bioretention soil may be watered to encourage compaction.

3.2 CLEANING

Thoroughly clean the inside of each existing piping system of all dirt, loose scale, sand, and other foreign material. Cleaning shall be by sweeping, flushing with water, or blowing with compressed air, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. Contractor shall be responsible for collection and disposal of all debris gathered from cleaning operations.

3.3 INSTALLATION OF PRECAST DRAIN INLETS

Set drainage pipe to grade as indicated in plans. Grout firmly in place to form a tight seal.

END OF SECTION

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fertilizers.
2. Plant Materials.
3. Rock Mulch.
4. Wood Chip Mulch.
5. Root Barriers.
6. Geotextile Fabric.
7. Staking and Guying.
8. Cobble.

B. For Earthwork, see Division 31.

C. For Landscape Maintenance Period, see Section 32 01 00.

D. For Irrigation, see Section 32 84 00.

E. For Planting Soil Preparation, see Section 32 91 13.

F. For Drainage, see Division 33.

1.2 DEFINITIONS

A. Acceptance: Wherever the terms “acceptance”, “accepted”, or “acceptable” are used herein, they mean acceptance of Owner’s representative in writing, unless indicated otherwise.

B. Tie Height: Lowest Height at which tree trunk will snap back to upright position when pulled to one side and released.

C. Plant Height: Measurement of main body height, not measurement to top branch tip.

D. Plant Spread: Measurement of main body diameter, not measurement from branch tip to tip.

E. Caliper: Trunk diameter measured at a point 6 inches (150 mm) above natural ground surface for trees up to 4 inches (100 mm) in caliper, and measured at a point 12 inches (300 mm) above natural ground surface for trees over 4 inches (100 mm) in caliper.

1.3 REFERENCES

A. ANSI — American National Standards Institute:
1. Z60.1 — American Standard for Nursery Stock. Most current edition.

B. ICBN — International Code of Botanical Nomenclature. Most current edition.

C. ICNCP — International Code of Nomenclature of Cultivated Plant. Most current edition.

D. NAAPS — National Arborist Association Pruning Standards. Most current edition.

E. UCDAS — University of California Division of Agricultural Sciences.
   1. Leaflet 2576 — Staking Landscape Trees. Most current edition.

1.4 SUBMITTALS

A. Product Data:
   1. Fertilizer Tablets.
   2. Geotextile Fabric.
   3. Wetting agent and Soil Penetrant.

B. Samples:
   1. Rock Mulch — 1/2 pound bag.
   2. Wood Mulch — 1/2 pound bag.
   3. Cobble- 5 pieces representing range of color and size.

C. Plant Material Photographs:
   1. At least 14 days prior to submittal of plant material location data, submit three color photographs of individual plants, each of representative plants of each type of plant material. Plants photographed should not have plants in the background or be of groups of plants.
   2. Include a scale object in each photograph such as a tape measure or person.

D. Plant Material Location Data:
   1. Quantities and sizes of each plant material type at each nursery or other place of growth.
   2. Address, phone number, and contact person for each nursery or other place of growth.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
   2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handling Plants:
   1. Do not lift or handle container plants by tops, stems or trunks.
   2. Do not bind or handle plants with wire or rope.
   3. Pad trunk and branches where hoisting cables or straps contact.

B. Anti-Desiccant:
   1. Spray plant material in full leaf immediately before transporting with anti-desiccant.
   2. Meet requirements of anti-desiccant manufacturer's current printed application instructions.

C. Digging Plants: Dig ball and burlap plants with firm, natural balls of earth of diameter meeting or exceeding requirements of ANSI Z60.1 and of sufficient depth as required to include the fibrous and feeding roots.

D. Plant Storage Prior to Installation:
   1. Protect plant root balls from sun and drying winds.
   2. Keep root balls moist.
   3. Keep sun-sensitive plants shaded.
   4. Anchor plants to prevent damage from strong winds.

1.7 SITE CONDITIONS

A. Environmental Requirements:
   1. Protect plant material being stored on site from sun and drying winds.

B. Existing Conditions:
   1. Prior to Work commencement, review and clearly mark in field horizontal and vertical locations of public existing underground utilities and structures with respective utility companies.
   2. Prior to Work commencement, review and clearly mark in field horizontal and vertical locations of private underground utilities and structures with Owner.

1.8 WARRANTY

A. Warranty Period: Warrant that plant material, except annuals, will be healthy and in vigorous, flourishing condition of active growth one year from date of Final Completion.

B. Annuals: Warrant that annuals will be in a vigorous, flourishing condition of active growth until end of last annual change season.

C. Delays: Delays in completion of planting operations which extend the planting into more than one planting season shall extend the Warranty Period correspondingly.

D. Condition of Plants: Plants shall be free of dead or dying branches and branch tips, with foliage of a normal density, size and color.

E. Incorrect Materials:
   1. During Warranty Period, replace at no cost to Owner, plants revealed as being untrue to name.
   2. Provide replacements of a size and quality to match the planted materials at the time the mistake is discovered.

F. Replacements:

1. As soon as weather conditions permit, replace, without cost to Owner, dead plants and plants not in a vigorous, thriving condition, as determined by the Owner's representative during and at the end of Warranty Period.
2. Apply requirements of this Section to replacements.

G. Exceptions: Contractor shall not be held responsible for failures due to neglect by Owner, vandalism and other causes outside the Contractor's control.

1.9 MAINTENANCE

A. For Landscape Maintenance Period, see Section 32 01 00.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Fertilizer Tablets:
1. Gro Power, Inc. – www.gropower.com.
2. Grow Better – www.growbetter.com.
3. Agri Tab Corporation – www.agritab.com.
4. Or accepted substitute.

B. Anti-Desiccant:
1. Aquatrols Corporation – www.aquatrols.com.
2. Or accepted substitute.

C. Steel Header and Stakes:
1. The J.D. Russell Company – www.jdrussellco.com.
2. Or accepted substitute.

D. Stress Reducing Agent: EarthWorks – www.soilfirst.com.
2. Or accepted substitute.

E. Wetting Agent and Soil Penetrant:
1. Aquatrols – www.aquatrols.com.
2. Harell's – www.harrells.com.
3. Or accepted substitute.

F. Tree Stakes:
1. J. R. Partners – www.reddystake.com.
2. Or equivalent and accepted substitute.

G. Rock Mulch:
1. Lyngso – www.lyngsogarden.com
2. American Soil Products – www.americansoil.com.

H. Wood Chip Mulch:
   1. Lyngso – www.lyngsogarden.com
   2. American Soil Products – www.americansoil.com.
   3. Or accepted substitute.

I. Cobble:
   1. Lyngso – www.lyngsogarden.com
   2. American Soil Products – www.americansoil.com.
   3. Or accepted substitute.

J. MPS Capillary / Aeration System:
   1. Primescape Products Company, Deerfield, Ill., (800) 872-4361.
   2. Or accepted substitute.

K. Geotextile Fabric:
   1. Carthage Mills – www.carthagemills.com.
   2. Mirafi – www.tcmirafi.com.
   3. Or accepted substitute.

L. Root Barriers:
   1. Deep Root – www.deeproot.com.
   2. Century Products – www.centuryrootbarrier.com.
   3. Or equivalent and accepted substitute.

M. Root Ball Anchors
   1. Platipus Earth Anchoring Systems – www.platipus-anchors.com.
   2. Or equivalent accepted substitute.

2.2 SUBSTITUTIONS

A. Plant Material: Accepted substitute plants shall be true to species and variety and shall meet requirements of this Section except that plants larger than specified may be used if accepted.

2.3 MATERIALS

A. Plants:
   1. Growing Practices: Nursery grown in accordance with best horticultural industry practices.
   2. Nomenclature: Plant nomenclature shall meet requirements of ICBN and ICNCP.
   3. Climatic Growing Conditions: Grown under climatic conditions similar to those of project for at least two years unless otherwise accepted.
   4. Container Growth Limitations: Container stock excluding annuals shall have been grown in the containers in which delivered for at least six months, but not over two years.
   5. Root Ball Size: Meet or exceed requirements of ANSI Z60.1.

6. Branching: Structurally strong, able to stand upright without stakes or guys on a windless day; exceptionally heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be superior in form, number of branches, compactness and symmetry.
7. Vigor: Sound, healthy and vigorous, well branched and densely foliated when in leaf.
8. Disease and Pests: Free of disease, insect pests, eggs, or larvae.
9. Root System: Healthy well-developed root systems, free of kinked, circling, girdling and center roots, root-bound condition and cracked or broken root balls.
10. Measurements: Measure plants when branches are in their normal upright position.
11. Pruning: Do not prune, thin or shape plants before delivery without acceptance.
12. Unacceptable Conditions: Multiple leaders, unless specified, damaged or crooked leaders, bark abrasions, sun-scalds, disfiguring knots, or fresh cuts of limbs over 3/4-inch diameter which have not completely callused.

B. Fertilizer Tablets:
   1. Grow-Power 21 gram tablets, 20-10-5 (N-P-K) formula.
   2. Grow-Power 7 gram ADS tablets, 12-8-8 (N-P-K) formula.
   3. Agri Tab Aquatic fertilizer, 12-20-8 in compressed spike form.
   4. Agri Tab Aquatic fertilizer, 20-5-10 5 gram tablets.
   5. Or equivalent and accepted substitute.

C. Water: Clean, fresh and potable.

D. Wood Chip Mulch:
   1. Ground Fir 1/4 inch.
   2. Or equivalent and accepted substitute.

E. Rock Mulch:
   1. ½” x 3/8” crushed black basalt.
   2. Or equivalent and accepted substitute.

F. Cobble:
   1. 3” – 5” Black La Paz Cobble.
   2. Or equivalent and accepted substitute.

G. Anti-Desiccant: Commercially available spray protective coating, designed to reduce plant transpiration loss, which produces a moisture retarding barrier not removable by rain or snow.

H. Stress Reducing Agent:
   1. Roots Concentrate.
   2. Or equivalent and accepted substitute.

I. Wetting Agent and Soil Penetrant:
   1. AquaGro 2000M.
   2. AquaGro 2000G.

3. Or equivalent and accepted substitute.

J. Geotextile Fabric:
   1. Mirafi Filterweave 140 NC non-woven geotextile composed of polypropylene fibers.
   2. Carthage FX-300MF
   3. Or equivalent and accepted substitute.

2.5 SOURCE QUALITY CONTROL

A. Plant Material Review and Tagging:
   1. Trees will be reviewed, photographed and tagged by the Owner's representative at the nursery, or other place of growth prior to delivery of trees to site.
   2. At Owner's representative's discretion, shrubs may or may not be reviewed, photographed, and tagged by the Owner's representative at the nursery or other place of growth.
   3. Tagging of plant material at the nursery or place of growth does not cancel the right of the Owner's representative to reject plant material at the site, if damage or unacceptable conditions are found that were not detected at the nursery, place of growth or in the submitted photographs.

PART 3 — EXECUTION

3.1 EXAMINATION
A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
B. Fine Grading and Soil Preparation: Verify that fine grading and soil preparation Work is complete.
C. Verification Surface Drainage: Verify positive surface drainage of planted areas.
D. Notification: Before proceeding with Work, notify Owner and Owner's representative in writing of unsuitable conditions.

3.2 PREPARATION
A. Protection of Existing Conditions:
   1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
   2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
   3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
   4. Submit written notification of damaged plants and structures to Owner and Owner's representative immediately.

3.3 SUBSURFACE OBSTRUCTIONS

A. Plant Pit Excavation: If rock, underground utilities, structures, tree roots or other obstructions are encountered in the excavation of plant pits, alternate locations may be accepted by the Owner's representative.
B. Cost for Removal of Obstructions: Where locations cannot be changed, submit cost estimate for Work to remove the obstructions to a depth of not less than 6 inches below the required pit depth, and proceed with Work after Owner's approval.
C. Irrigation Piping: Reroute around the plant root ball.

3.4 HEADERS INSTALLATION

A. Locations: Install where indicated on Drawings.
B. Horizontal Alignment:
    1. Install straight sections free of "wiggles" using string lines as guides.
    2. Install curved sections as smooth curves free of small "wiggles" following alignment marked with paint by Owner's representative in field.
C. Vertical Alignment: Install parallel with finished grade.
D. Stakes:
E. Install stakes in solid undisturbed soil.
    1. Recompact loose disturbed soil to at least 85 percent relative compaction before installing stakes.
    2. Install stakes at every location in header sections designed to attach stakes to headers.
F. Damaged headers: Replace header sections damaged by construction operations.

3.5 PLANT LAYOUT

A. Trees:
    1. Stake location of trees where indicated on Drawings.
    2. Scale tree locations where no dimensions are given.
    3. Drive a 3-feet long wood lath stake at each tree location and mark each tree type with different color survey tape.
    4. Contact Owner's representative to review locations in field prior to excavating plant pits.
    5. Do not excavate plant pits until Owner's representative has accepted locations.
B. Shrubs and Groundcover.
    1. Layout according to Drawings.
    2. Contact Owner's representative if there are any conflicts that would prevent plants from being laid out according to Drawings.
    3. Contact Owner's representative to determine if a review of locations in field, prior to excavating plant pits, is required.

3.6 EXCAVATION OF PLANT PITS

A. Equipment:
    1. Excavate pits with a back hoe or hand digging.
    2. Do not use an auger.
B. Dimensions:

1. Excavate plant pits to a depth equal to the root ball height minus the amount needed to account for settlement and to install the root balls at the specified elevation relative to adjacent finished grade.
2. Install top of plant root balls 1-inch above adjacent finished grade except where indicated otherwise.
3. Excavate pits to a diameter which is 3 times the root ball diameter, except where indicated otherwise on the Drawings.
4. Center plant pits on plant locations where possible.
5. Where plant pits cannot be excavated to specified dimensions nor centered on plants due to obstructions such as paving, walls, curbs, or other structures excavate pits in directions without obstructions until pit volume equals the specified plant pit volume, except where indicated otherwise.
6. Do not undercut adjacent obstructions unless accepted by the Owner's representative.
7. Excavate plant pit sides along adjacent elements such as paving, walls, curbs, and other structures at a 45 degree angle sloping away from the bottom surfaces of the adjacent elements, except where indicated otherwise.

3.7 ROOT BARRIERS INSTALLATION

A. Locations: Install root barriers where shown on Drawings and according to manufacturer's current printed instructions.

3.9 PLANTING AND BACKFILL OPERATIONS

A. Protection of Plants Prior to Installation:
   1. Protect plant root balls from sun or drying winds.
   2. Keep root balls of plants that cannot be planted immediately upon delivery in the shade, well protected and well watered.
B. Removal of Containers:
   1. Remove canned stock carefully after cans have been cut on two sides with accepted cutter.
   2. Do not use spade to cut containers.
C. Root Ball Scarification:
   1. After removing plant from container, scarify side of root ball to prevent root bound condition.
   2. Loosen root ball soil surface to depth of 1/8 to 1/4 inch without damaging roots or breaking root ball.
   3. Do not scarify or cut into Bougainvillea root balls.
D. Cutting Circling Roots:
   1. If circling roots are encountered at root ball sides, notify Owner's representative for field review.
   2. Upon Owner's representative's acceptance, cut roots on 4 sides of root ball 90 degrees apart at no extra cost to Owner.
   3. Use a 4-inch wide sharp straight blade.
   4. Cut roots by pushing spade or knife down sides of root ball 90 degrees to root ball surface and 2 inches into root ball.
   5. Keep spade or knife sharp to cut roots cleanly.
E. Plant Placement:

1. Handling plant carefully, set plant root ball on pit bottom centered on accepted horizontal location.
2. Install plant root ball vertically so that top of root ball is 1 inch above adjacent finished grade after settlement except where indicated otherwise.

F. Removal of Root ball Wrapping Materials: Remove and dispose of burlap, nylon cord, wire baskets, twine and other materials prior to backfilling.

G. Backfill Mix Placement:
1. Place mix carefully as not to damage the plant root ball, trunk, branches, or foliage.
2. Fill pit until top of backfill mix is even with top of root ball.
3. Settle mix by watering evenly.
4. Fill settled backfill mix with additional soil mix as required to bring it even with top of root ball.
5. Continue filling and watering settled areas until settlement stops.

H. Settled Plant Adjustment: Raise plant root balls which settle so that top of root balls are at the specified elevation relative to adjacent finished grade.

I. Final Compaction: Compact soil mix by saturating with water.

J. Fertilizer Tablets:
1. Place maximum quantities recommended by the manufacturer's current printed instructions.
2. Place tablets between bottom of root ball and 1/3 way up root ball, 2 inches away from root ball.
3. Do not place tablets higher than 1/3 way up root ball.
4. Space tablets equally around root ball.
5. Install tablets at trees, shrubs, ground cover, ornamental grasses, and ferns.

K. Stress Reducing Agent:
1. After backfilling plant pits, drench backfill at rates recommended by manufacturer.
2. Drench backfill same day backfill is placed.

L. Wetting Agent and Soil Penetrant:
1. After backfilling plant pits, drench backfill at rates recommended by manufacturer.
2. Drench backfill same day backfill is placed.

3.10 TREE STAKE INSTALLATION

A. General: Install stakes plumb and per Manufacturer's current printed instructions.

B. Size and Quantity: Refer to Schedule at end of this Section.

C. Orientation:
1. Locate stakes in a line with trunk of tree, as close to the main trunk as possible without penetrating root ball.
2. Locate line of stakes and trunk perpendicular to the prevailing wind direction.
3. Owner's representative will determine directional orientation in the field.

D. Stake Depth:
1. Drive 8 feet long stakes two feet into firm, undisturbed ground below the plant pit bottom.
2. Drive 10 feet long stakes 3 feet into firm undisturbed ground below plant pit bottom.

3. Pre-drill pilot holes one half diameter of stake if required to drive stakes in hard soil conditions.

E. Tying to Stakes Trees Not Able to Stand Upright Without Support:
   1. Meet requirements of UCDAS Leaflet 2576 Staking Recommendations for trees requiring tree support.
   2. Hold trunk in one hand, pull top to one side and release to determine tie height.
   3. The height at which trunk will just return to upright when the top is released is the tie height.
   4. Loop ties around trunk at tie height and cross ends forming figure 8 shapes.
   5. Tie ends of ties with double-back locking configuration as recommended by the tie manufacturer.
   6. Nail rubber ties to stakes at tie height using 2 galvanized roofing nails at each end of tie.
   7. Cut off remaining stake 2 inches above upper tree tie.

F. Tying to Stakes Trees Able to Stand Upright Without Support:
   1. Refer to detail on Drawings.
   2. Tie ends of ties with double-back locking configuration as recommended by the tie manufacturer.

3.11 ROOT BALL ANCHOR INSTALLATION

A. Manufacturer's Requirements: Meet requirements of manufacturer's current printed instructions.
B. Root Ball Characteristics:
   1. Install anchors only on firm root balls.
   2. Do not install anchors on trees grown in sand, sawdust or other loose growing mixes.

3.12 WOOD CHIP MULCH INSTALLATION

A. Depth: Install a 3-inch deep layer of mulch at locations shown on the Drawings.
B. Surface: Rake mulch surface smooth.
C. Woody Plant Stems: Slope mulch away from woody plant stems so that mulch does not touch stems.

3.13 ROCK MULCH INSTALLATION

A. Depth: Install a 3-inch deep layer of rock mulch at locations shown on the Drawings.
B. Surface: Rake mulch surface smooth.
C. Woody Plant Stems: Slope mulch away from woody plant stems so that mulch does not touch stems.

3.14 COBBLE INSTALLATION

A. Depth: Install cobble with a minimum depth of 2 layers of stone at locations shown on the Drawings.
B. Surface: Adjust cobbles by hand to achieve a stable and even surface.

3.15 FIELD QUALITY CONTROL

A. Field Observation Reviews by Owner's representative: Coordinate and schedule with Owner's representative.

3.16 SCHEDULES

A. Tree Stake Schedule:

Tree Caliper at 12 inches	*Number of Inches Diameter × Above Grade*	*Stake Size Stakes × Feet Length*
To 1-3/4 inches	2.0	2 inches × 8 feet
2 to 3 inches	2.0	3-l/2 inches × 10 feet

B. Tree Guy Schedule:

Tree Caliper at 12 Inches Above Grade	*No. of Guys*	*Cable Size*	*Turn-buckle Size*	*Ground Anchors*
3 - 6 inches	3	1/8 inch 7 × 7	1/4 × 4 inches	4 × 4 × 24 × 18 inches deep deadmen (or) Laconia LA-4-40 SM (or) Duckbill 68
6 - 8 inches	3	3/16 inch 7 × 7	5/16 × 4-1/2 inches	6 × 6 × 30 × 30 inches deep deadmen (or) Laconia LA-6-60 (or) Duckbill 88
8 - 10 inches	3	1/4 inch 7 × 19	3/8 × 6 inches	6 × 6 × 36 × 36 inches deep deadmen (or) Laconia LA-8-90 (or) Duckbill 88
10 - 12 inches	3	5/16 inch 7 × 19	3/8 × 6 inches	8 × 8 × 48 × 48 inches deep deadmen (or) Laconia LA-10-120 (or) Duckbill 138

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for providing water service and distribution and modification to existing water mains and services as indicated. The extent of water distribution is indicated on the Contract Drawings and includes furnishing, installing, testing, and disinfecting permanent water supply piping and services as indicated.

B. The jurisdictional water utility district shall provide water services to the water meter as indicated on the Contract Drawings. The Contractor shall be responsible for making all such arrangements. All work on the jurisdictional agency's facilities shall be in accordance with the agency's adopted standards and performed by the agency or their representative.

1.2 RELATED SECTIONS

A. Section 31 23 33 – Trenching and Backfilling

1.3 REFERENCES

A. Codes and Standards: The design and installation of underground water piping shall conform to the following codes and standards except as specifically noted in these standards.

1. Latest edition of the California Plumbing Code (CPC)
2. Latest edition of the California Fire Code
3. Latest edition of the California Building Code
4. Latest adopted edition of the National Fire Protection Association (NFPA) 24: Standard for the Installation of Private Fire Service Mains and Their Appurtenances
5. American Water Work Association (AWWA) standards and manuals as appropriate for installation and materials including, but not limited to:
    a. C-104 (2013): Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
    b. C-105 (2010): Polyethylene Encasement for Ductile-Iron Pipe Systems
    c. C-150 (2008): Thickness Design of Ductile-Iron Pipe
    d. C-151 (2009): Ductile-Iron Pipe, Centrifugally Cast for Water
    e. C-504 (2010): Rubber-Seated Butterfly Valves
    f. C-600 (2010): Installation of Ductile-Iron Water Mains and Their Appurtenances
    g. C-605 (2013): Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for water
    h. C-651 (2014): Disinfecting Water Mains
    i. C-900 (2007): Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 12 in. (100 mm Through 300 mm), for Water

Transmission and Distribution

j. M-11 (2004): A Guide for Steel Pipe Design and Installation, 4th Ed.
k. M-14 (2014): Recommended Practice for Backflow Prevention & Cross-Connection Control, 4th Ed.
l. M-23 (2002): PVC Pipe - Design and Installation, 2nd Ed.
m. M-27 (2013): External Corrosion: Introduction to Chemistry and Control, 2nd Ed.
n. M-41 (2009): Ductile-Iron Pipe and Fittings, 3rd Ed.
o. M-55 (2006): PE Pipe—Design and Installation, 2nd Ed.

1.4 SUBMITTALS

A. Shop Drawings, Product Data, and Samples

B. Shop drawings showing all piping layout and pipe sizes, valves, backflow prevention device, and locations of tie-ins, buttresses, and thrust blocks.

C. Manufacturer's product data for manufactured materials and equipment, including all valves and backflow prevention device.

1.5 SITE CONDITIONS

A. Excavations in which products will be buried shall be dry.

B. Coordinate the installation of water supply system with the jurisdictional water utility owner. Contractor shall coordinate with jurisdictional water utility owner for installation of the new domestic water meter and water lateral within the City right-of-way. The jurisdictional water utility owner shall install the new domestic water lateral from the existing water main to the new water meter. Contractor shall coordinate depth and location of new domestic water lateral with the jurisdictional water utility owner.

C. Existing Underground Piping: Existing utilities and piping, where known, are shown on the Drawings. Exact locations and depths of existing lines must be determined in the field by the Contractor by exploration using methods which will not damage any existing improvements.

D. Location and Alignment of New Work: Pipe alignments may be varied from those shown on the Drawings when field conditions indicate that the change would be advantageous. Any such proposed changes shall be brought to the attention of the Engineer. Changes shall not be made until written approval from Engineer has been obtained. Provide traffic cover plates over trenches at streets, parking areas and pedestrian pathways to maintain access, unless closure is permitted by the Engineer.

E. Interference with Normal Operations at the Site: All pipe work shall be coordinated with the required excavation and backfill so that there will be a minimum of interruption in the normal use of roads, parking areas, pathways and other existing facilities.

F. At least one week prior to the shutdown the Contractor shall submit to the Engineer a schedule and plan showing the following: a) how connections to existing facilities are

to be made; b) length of time required to accomplish the work and to get the systems into service, and c) a list of all equipment and materials required to make the tie-in. The shutdown will not be permitted to commence until the Contractor has received written permission from the Engineer and the Contractor has provided assurance to the Engineer that all necessary material, equipment and manpower will be available at the proper time so that the shutdown will proceed on schedule.

PART 2 - PRODUCTS

2.1 Valves and Cocks

A. Water: 250 lbs minimum AWWA standard, Pratt butterfly valve or equal with ends to suit pipe used. When below grade, delete hand wheel and install operating nut and valve box.

B. Install traffic rated concrete valve boxes (e.g.: G-5 Christy) and extensions to grade. Cover shall have type of service (water, gas, etc.) cast in.

C. Provide one tee handle operating wrench for each size operating nut, with length to suit maximum valve depth. See Appendix, Typical Water Service and Piping Systems, for PVC details for extension stem.

2.2 PIPE MATERIALS, SIZES AND OTHER REQUIREMNTS

A. All piping is to be either:

1. Cement-lined ductile-iron pipe (DIP) may be used only in underground fire service mains supplying building fire protection systems, which shall use cement-lined ductile-iron pipe from five feet (5’-0”) outside of the foundation wall through the foundation wall to the inside of the building and be fitted with a Link Seal (or equal) device to prevent transfer of water through the wall.

2. Domestic water lateral shall be ASTM B88 type “K” copper pipe with brazed joints using minimum 15 % silver brazing alloy. At interior installations, pipe 3 inches and smaller shall be ASTM B88 type “L” copper pipe with lead-free solder joints.

B. Couplings and pipe thread adapters for copper tubing shall be Mueller 110 compression connection series or equal. Soldered joints are not allowed.

C. All ferrous materials, restrainers, T-Head bolts, clamps, joint restraint clams, washers, tie rods, bolts and nuts shall have at least one coat of protective coating (bituminous mastic) of an approved type before backfilling.

D. All restrainers and ductile-iron fittings shall be wrapped with at least one layer of 10-mil plastic.

E. All ductile-iron pipe shall be wrapped with at least one layer of 10-mil plastic.

F. Hot tapping and use of saddles are not permitted.

G. Refer to the latest edition of the California Building Code. Materials and systems must

be based on a comprehensive review of the project design requirements. Use of non-standard materials requires the express written consent of the Engineer.

2.3 Valves

A. Valves shall conform to AWWA C-504. Valves shall be Pratt Butterfly Valves (or equivalent) except as required by section (5) (below).

B. Indicating posts used for underground valves or wall indicating valves shall be of the type that use the words “OPEN” when the valve is open and “SHUT” when the valve is closed. Mueller gate valves with a resilient seal (or equivalent) shall be used.

C. Valves shall open when turned counter-clockwise.

D. The pressure ratings for all valves shall be as follows: Table 1 Pressure Zone Hydrostatic Test Pressure (PSI) Rated Working Pressure (PSI) High 200 or 50 psi + max static pressure 250 Medium 200 250 Low 200 250

E. A concrete pad shall be placed under all valves.

PART 3 - EXECUTION

3.1 GENERAL

A. After demands are determined, size water lines on the basis of friction loss. Do not exceed ten percent (10%) of the initial pressure at full demand or 7.5 feet per second velocity with a minimum pressure of 60 psi for building services.

B. Show valves at all services from mains and at other points to minimize disruption of building operations. Valves should be located at the building exterior and where mains enter the building.

C. Use separate cold water services for domestic and fire where it is from the University system.

D. Use two pressure zones where the pressure at the lowest point of use will exceed 80 psi to maintain 35 psi at the highest point of use.

E. Thrust blocks shall be as indicated in the plans

F. Fire protection service from single building service.

1. Fire Sprinklers

a. Provide separate service from exterior mains for buildings served by the utility company.

3.2 MAINTAINING WATER SERVICES

A. Maintain water service and conduct operations at times selected to minimize duration and inconvenience of service interruption.

B. Water valves in service owned by the jurisdictional water utility Owner shall be

operated only by personnel of that jurisdictional water utility district.

C. Except as specified otherwise herein, and where applicable, materials and construction methods shall be in accordance with the provisions of the jurisdictional water utility district standard drawings and specifications.

3.3 INSTALLATION

A. Installation Requirements

1. Excavating and backfilling, including bedding and compacting requirements, to the backflow preventer assemblies shall be in accordance with the provisions of the jurisdictional water utility district standard drawings and specifications. Excavating and backfilling, including bedding and compacting requirements, beyond the backflow preventer assemblies shall conform to Section 312333 - Trenching and Backfilling.

2. Provide concrete thrust blocks for elbows, tees, valves, and appurtenances of buried piping. Thrust blocks shall be constructed as indicated.

3. Install piping true to line and grade, supported and guided to assure alignment under all conditions.

4. Install unions at each connection to valves.

5. Make change in line with fittings. Do not spring joints to effect change of direction.

6. Do not field cut pipe unless necessary. Make such necessary cuts by means of equipment designed for the purpose, ensuring a smooth square end.

7. For connection to existing pipe, provide pipe with suitable ends or adapters, after verification of size and type of existing pipe.

B. Valves

1. Install valves in accordance with the valve manufacturer’s installation instructions.

2. Where valves are provided by the jurisdictional water utility, provide suitable access for operation of valves.

C. Thrust Blocks and Harnessing

1. Provide for counteracting thrust caused by static and dynamic forces, including water hammer at bends, tees, reducers, valves, and dead-ends by installing harnessing as indicated or required. For other methods, submit details for approval of the Engineer prior to use.

2. Provide concrete thrust blocks as indicated where harnessing is not practicable.

D. Water Service Connectors

1. Make water service connections, as indicated, in accordance with California Plumbing Code and the installation instructions of the service pipe and fittings manufacturer.

E. Acceptance Requirements

1. After installation of pipes, ends of pipes shall be either capped or plugged. No piping shall be buried before being inspected and tested.

F. Corrosion Protection

All buried ferrous metal fittings and appurtenances shall be provided with bituminous coating corrosion protection and as indicated in the design plans.

1. Ferrous metal fittings and appurtenance as herein referred to are: valves, tees, elbows, reducers, crosses, plug assemblies, pumping tees, services, blowoff installations, flexible couplings, leak clamps, tie rods, etc.

2. Joints, fittings, and appurtenances that are required to be coated by the Contractor may be coated before or after installation in the trench.

3. Cast-iron pipe or bare metal pipe extending into the soil from a concrete structure shall be insulated from the concrete and leak-proofed. The insulation shall extend through the concrete a minimum of three (3) inches on each side. The insulation shall consist of one layer of Scotchrap Tape No. 50 and two coats of bituminous paint. The pipe shall be clean, dry, and free from loose scale before applying the adhesive and tape. The edges of the tape shall be lapped not less than one-half (1/2) inch.

4. Bituminous coating shall be applied in <u>two coats</u> with a minimum 20-mil dry thickness per coat. Applications shall be in accordance with manufacturer's instructions. Allow first coat to dry as recommended by the manufacturer before application of second coat. Allow second coat to dry before encasing in polyethylene tubing or wrap. Inspector must inspect coating prior to covering with polyethylene. Joints must be not be covered with polyethylene during the pressure test witnessed by the Owner’s Representative.

3.4 TESTS

A. Protection from Flooding

Provide positive measures to protect exposed, installed pipe and compacted pipe bedding from flooding during testing.

B. Notice of Testing

1. Give three (3) days notice of intention of testing to the Engineer and jurisdictional agency. The Contractor will furnish, install, and operate pumps, gages, meters, and individual pipe connections to test openings.

2. Designate largest sections feasible for testing and sterilizing.

C. Testing Requirements

1. Prior to backfilling, isolate system by use of approved valves, caps and plugs, or other means.
2. Maintain such isolation throughout the performance of leakage and pressure testing.
3. Where valves are used for isolation, eliminate leakage through such valves if it occurs. Maintain new work isolated from existing water mains, except for test connections, until testing and sterilization have been completed.
4. For hydrostatic tests, provide approved caps and plugs in sections to be tested and remove them after testing.
5. Prevent leakage in pipes and fittings at openings. Temporarily block plugged and capped ends to prevent displacement.
6. Install water source connection for testing, as directed.
7. Provide labor and materials required for leakage testing, including excavation for installation and removal of pumps, gages, meters, and water source connections.
8. Where leakage exceeds the Owner's standards, perform necessary corrective measures.
9. Remove and replace defective pipes, joints, fittings, valves and appurtenances. Reset such items if displaced.

D. Hydrostatic Tests

1. Perform hydrostatic tests in accordance with the Owner's requirements. All such tests shall be witnessed by the representative. The Contractor shall be responsible for making all such arrangements.
2. Test the fire water system hydrostatically in sections to a pressure of at least 200 psi for not less than 120 minutes. Test the domestic water system for building service lateral(s) at 60 psi for 120 minutes. Pressure test pipe before backfilling. Repair leaks and retest the system until the system is leak free. Use instruments calibrated by a quality laboratory.

   Test sequence shall be as follows:

   a. Lines shall be fully flushed.
   b. Lines shall be hydrostatically tested.
   c. Lines shall be fully flushed.
   d. Lines shall be fully disinfected.

3.5 SYSTEM DISINFECTION

A. Standard Disinfection Procedure For Domestic Water System

1. Supervision and Testing: Perform entire disinfection procedure under the

supervision of Environment, Health and Safety (EH&S). Provide five (5) days' notice to schedule procedure.

2. Contractor's Responsibility: Furnish a copy of the California Department of Pesticide Regulation (DPR) Qualified Applicator License, equipment, materials and transportation to disinfect domestic hot and cold water systems and fire lines directly connected thereto, in conformity with procedures and standards described herein.

3. Disinfecting Agent: An aqueous solution of sodium hypochlorite (minimum 5.25% available chlorine). The use of powdered hypochlorite and chlorine gas are prohibited unless specifically approved by Environment, Health and Safety (EH&S).

4. Preliminary Preparations:

    a. Service Cock: Provide within three feet (3'-0") of the entrance of the supply main to the building, a three-quarter inch (3/4") service cock, or valve, for the purpose of introducing the disinfecting agent.
    b. Flushing: After final pressure tests and before draining for disinfection, open each fixture or outlet until the water flow is clear.

5. Disinfection Procedure:

    a. Drain entire domestic water system including fire line.

    b. Post suitable warning signs at each outlet: Warning - Do Not Use - Water System Being Chlorinated.
    c. Inject disinfectant solution into the system through the service cock by means of a pump, or other pressure device, at a slow continuous rate, simultaneous with a reduced flow from the water main, until the Ortho-Tolidin test for residual chlorine at each outlet shows a concentration of at least 50 ppm, but note more than 100 ppm.
    d. Close all outlets and valves, including the service valve at the main and the injection cock. Retain the chlorinated water in the system for 24 hours.
    e. After the 24 hour holding period, the residual chlorine concentration shall be not less than 50 ppm as shown by the Ortho-Tolidin test.
    f. Drain and flush entire domestic water system until Ortho-Tolidin tests show background residual chlorine concentration at any and all outlets.
    g. Environment, Health and Safety (EH&S) shall determine whether samples of water must be collected and analyzed for the determination of bacteriological quality.

6. Standards Necessary for Approval:

    a. The water system shall have been uniformly chlorinated under the supervision of Environment, Health and Safety (EH&S) as outlined above.
    b. The results of water sample analysis shall be negative for the Coliform organisms.
    c. If the test for the bacteriological quality of the water in the system does not meet the standards, repeat the disinfection procedure until the specified standards are met.

d. Final Approval: Environment, Health and Safety (EH&S) shall give written approval to the University for acceptance and use of the water system after the above procedures have been successfully completed and the standards met.

3.6 CONNECTIONS TO EXISTING MAINS

A. Following testing and sterilization, new water distribution lines shall be connected to the existing main as indicated. The connection shall be made at a time and in a manner which will result in the least interruption of service.

B. All connections involving shut down of jurisdictional water utility's existing facilities shall be made under the immediate supervision of the jurisdictional water utility district. No member of the Contractor's forces may operate any valve controlling the flow of water in the water utility's existing system.

C. The Contractor shall make tie-ins to the existing system at a time which is convenient to jurisdictional water utility district, which may be in the evenings and on weekends.

D. All piping to be abandoned, as shown on the plans, is abandoned only when the pipe has been taken out of service, physically disconnected from the active water system, and has been sealed by the Contractor.

E. The Contractor shall seal all cut ends of the existing piping that are not connected to the new system by either installing temporary fittings on the existing pipe or by plugging the cut end with concrete extending two pipe diameters into the pipe. After the concrete placement, the pipe end shall be blocked with a two-inch thick redwood block.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all solid wall pipe as indicated in the Drawings; and all appurtenant work, complete and operable, including all manholes, cleanouts, fittings and connections as shown on the Drawings and as specified herein.

B. Piping under existing pavement and retaining walls may be installed by jacking, boring or by hydraulic driving except as otherwise indicated in Drawings or directed. Use existing sleeves where applicable. At location where cutting is required make all cuts clean using power saws. Replace and restore all surfaces to original conditions, including grades and landscaping. Match restoration work with original work in every respect, including type, strength, texture and finish.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 23 24 Trench Excavation and Backfill

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ASTM A 48	Specification for Gray Iron Castings.
ASTM C 150	Specification for Portland Cement.
ASTM C 478	Specification for Precast Reinforced Concrete Manhole Sections.
ASTM D 3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 477	Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.4 CONTRACTOR SUBMITTALS

A. Certificates of Compliance: Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

B. Submit plan and profile drawings for sewer connection showing pipe sizes, location, alignment of sewer service and elevations along with the details associated with the improvements, location of boring pits.

1.5 QUALITY ASSURANCE

A. Tests: All materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

B. All costs of such inspection and tests shall be borne by the CONTRACTOR.

C. The pipe shall be subjected to the specified hydrostatic strength tests, flexure tests, and crushing tests. The crushing tests shall be made on samples taken from the center of full-length sections of pipe.

1.6 PROJECT CONTROLS

A. Interruption of Existing Sanitary Sewerage: Do not interrupt service to facilities occupied by District or others unless permitted under the following conditions and then only after arranging to provide temporary service according to the requirements indicated:

1. Notify the ENGINEER no fewer than eleven (11) working days in advance of the proposed interruption of service.

2. Do not proceed with interruption of service without ENGINEER'S written permission.

3. Submit plans to the ENGINEER showing rerouting of the temporary sanitary sewer service and obtain written approval from ENGINEER prior to proceeding with the work.

PART 2 - PRODUCTS

2.1 GENERAL

A. All solid wall pipes shall be continuously and permanently marked in conformance with the appropriate ASTM.

B. The CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe.

C. Pipe shall be of the pipe pressure class as shown on the Drawings.

2.2 PIPE

A. HDPE DR 17 (125 PSI) ASTM F714, ASTM D3035, ANSI/AWWA C906

1. Sanitary sewer pipes shall be green colored. If not manufactured green, sanitary sewer pipes shall be wrapped with Christy ™ TA-33-PW21, 2" x thick green 10mil polywrap, or approved equal.

2.3 FITTINGS

A. All fittings including wyes and sanitary sewer lateral cleanouts for pipe shall conform to the requirements of ASTM D 2657, D3350, AND AWWA C906.

B. The strength class of the fittings shall be not less than the strength class of any adjoining pipe.

2.4 BEDDING MATERIAL

A. Unless otherwise specified or shown, all material used for pipe bedding shall conform to the requirements for bedding in Section 31 23 24 “Trench Excavation and Backfill”.

2.5 FLEXIBLE COUPLINGS

A. Flexible couplings used for repairs shall be rubber, full-circle, clamp-on type conforming with ASTM C 425 and provided with 2 stainless steel band screw-clamps to secure the coupling tightly to entering and exiting pipes. All screw-clamp hardware shall be Type 304 or Type 316 stainless steel. Rubber material shall be suitable for use on sewage systems. Sanitary sewer connection at the building point of connections shall be made by using Calder Couplings or approved equal.

2.6 LATERAL CONNECTIONS TO SANITARY SEWER

A. Service lateral connections to new sewers shall be made with Wye fittings, installed as the sewer pipe is laid.

B. Service lateral connections to existing sewer lateral shall be made approved by the City of Berkeley Engineer.

PART 3 - EXECUTION

3.1 GENERAL

A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the ENGINEER, and shall be subject to its approval before acceptance. All material found during the progress to have defects will be rejected and the CONTRACTOR shall promptly remove such defective materials from the site of the WORK.

3.2 TRENCHING AND BACKFILL

A. Trench excavation and backfill shall conform to the requirements of Section 312324 “Trench Excavation and Backfill” and as specified herein.

3.3 PIPE LAYING

A. The pipe shall be installed in conformance with the requirements of ASTM D 2321, as specified herein and as shown on the Drawings. The pipe sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for connecting joints, the bedding for the pipe shall be checked for firmness and uniformity of surface.

B. Proper implements, tools, and facilities as recommended by the pipe manufacturer's printed instructions shall be provided and used by the CONTRACTOR for safe and efficient execution of the work. All pipe, fittings, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or will produce ragged, uneven edges.

D. Installation of pipes in prepared trenches shall start at the lowest point, with the spigot ends pointing in the direction of flow.

E. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.

F. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the CONTRACTOR at its own expense.

G. Installation of Warning Tape shall be THOR ENTERPRISES, CALPICO, or equal. Tape to hold the wire in place shall be pipe wrap tape, 2 inches wide, 10 mil.

3.4 PIPE HANDLING

A. Handling of all pipe shall be done with care to insure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.

B. Pipe shall be inspected both prior to and after installation in the trench and all defective lengths shall be rejected and immediately removed from the working area.

3.5 FIELD JOINTING

A. Each pipe elastomeric-gasket joint shall be installed in conformance with the manufacturer's printed recommendations. Elastomeric Gaskets shall be conform to ASTM D3212.

B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint.

C. The pipe shall not be deflected either vertically or horizontally in excess of the printed recommendations of the manufacturer.

D. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and re-laid in an acceptable manner. No pipe shall be laid when, in

the opinion of the ENGINEER, the trench conditions or weather are unsuitable for such work.

3.6 FITTINGS

A. All fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into trench by acceptable means without damage to the fittings. Fittings shall be carefully connected to pipe or other facility, and joint shall be checked to insure a sound and proper joint.

3.7 SANITARY SEWER CLEANOUTS

A. Two-way Sanitary Sewer Clean outs on 4 inch sanitary sewer laterals shall be cast iron ANACO, Two-Way Combination Clean-out; American Brass and Iron; or equal. Sanitary sewer cleanouts on 6 inch and larger pipe shall be a combination Wye and 1/8th bend, ANACO; American Brass and Iron; or equal.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section Includes: Furnish and install all structures, piping, fittings, and accessories, and perform all earthwork, grading, adjustments of inlets and flushing of all existing systems as shown on the Drawings, described in these specifications, and as required to construct a complete and operable storm water runoff drainage system.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

B. State of California, Department of Transportation, Standard Specifications (Standard Specifications) Current Edition.

C. Standard Specifications for Public Works Construction written by the Southern California Chapter, American Public Works Association

1.3 SUBMITTALS

A. Submit the following in the Product Information category.

1. Shop Drawings: Submit detailed drawings and specifications on all precast drop inlets, junction boxes and accessories, including gratings, covers and frames.

1.4 QUALITY ASSURANCE

A. All products and materials furnished under this Section shall be of a manufacturer who has been regularly engaged in the design and manufacture of said products and materials for a period of at least 5 years. If the product of an alternate supplier is proposed, it shall be demonstrated to the satisfaction of the Owner's Representative to be of a quality and serviceability equal to the product made by the manufacturer specifically named herein.

B. The Owner will inspect and verify percent of slope.

PART 2 - PRODUCTS

2.1 PRECAST DRAIN INLETS, GRATES AND FRAMES

A. Drain Inlets and Junction Boxes: Precast concrete structures, sizes appropriate designed to withstand an AASHTO H-20 loading. Provide interlocking joints where depth requires more than one unit. Minor variations from the drawings may be accepted to permit the use of manufacturer's standard methods of fabrication. Manufacturers: Santa Rosa Cast Products Company; Christy; or equal. Contractor shall be responsible for field verifications for sizing of all storm drain elements.

2.2 STORM DRAINAGE SYSTEM PIPES

A. High Density Polyethylene Pipe (HDPE)

1. Pipe: HDPE pipe conforming to ASTM D3212, or ASTM 1417 (ADS N-12 1B WT pipe or equivalent)
2. Fittings shall be the same material as pipe molded or formed to suite pipe sizes and end design

B. Sidewalk Underdrain

1. See Section 2.1 Precast Drain Inlets, Grates and Frames for junction box
2. See Section 32 16 13 Concrete Curbs, Gutters, and Sidewalks for concrete materials
3. Box Steel Pipe - AWWA C200, Sch. 40 for use with sidewalk underdrains, as indicated in plans

C. Inlets / Area Drains

1. Grates and frames shall be ADA compliant, bicycle-proof and supplied by the manufacturer of the catch basin and be matched to the Drain Inlet.
2. Christy 12” x 12” drop inlet with cast-in frame, or approved equivalent
3. Area drain atrium grate shall be NDS Atrium Grate, Green or approved equivalent
4. Pop-up drainage emitter shall be NDS Pop-up Drainage Emitter or approved equivalent

PART 3 - EXECUTION

3.1 CLEANING

A. Thoroughly clean the inside of each existing piping system of all dirt, loose scale, sand, and other foreign material. Cleaning shall be by sweeping, flushing with water, or blowing with compressed air, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. Contractor shall be responsible for collection and disposal of all debris gathered from cleaning operations.

3.2 FIELD TESTING

A. Perform leakage tests on all pipe installed in this project. Water exfiltration test or air pressure test in accordance with Section 306-1.4 of the Standard Specifications for Public Works Construction written by the Southern California Chapter, American Public Works Association, et al.

3.3 INSTALLATION OF PRECAST DRAIN INLETS

A. Install drain inlets, level and set to grade, on a 6-inch sand or gravel leveling course, compacted to 95% relative density. Grout firmly in place to form a tight seal.

B. Set drainage pipe to grade as indicated in plans. Grout firmly in place to form a tight seal.

END OF SECTION

LUMINAIRE CUTSHEETS

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

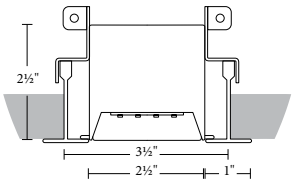
High Performance 2.5" Aperture (HPX) Recessed

The High Performance 2.5" Aperture (HPX) is a patented LED linear luminaire with a square micro profile and internal driver design. This Line-of-Light luminaire delivers excellent performance and is equipped with a unique LED configuration for superior illumination. HPX can be tailored from 2' to 12' sections in 1' increments and is available in Pendant, Surface Mount, and Recessed.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

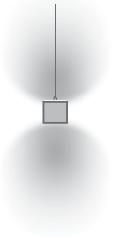
CROSS SECTIONS

Recessed



Flush Downlight Diffuser
(standard)

ALSO AVAILABLE IN



Pendant
(**ID, D**)

Surface Mount
(**SM**)

LUMEN OUTPUT PACKAGES

S	B	H	V
Standard	Boosted Standard	High	Very High

PERFORMANCE

Up to **2057** **Lumens** per **Foot**

Up to **125** **Lumens** per **Watt**

Fine TUNE Option Available

Protected by one or more US Patents: 8915613; 9681516,B2; D702,390

A brand of legrand

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

Clear Form

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Run Length of Configuration
⦿ HP - High Performance	⦿ X - 2.5" Square	⦿ R - Recessed	⦿ D - Direct	_____ Minimum 2' section length. Increments of 1'; 12' maximum section length

OUTPUT AND LED TYPE / MECHANICAL/ OPTICAL OPTIONS / ELECTRICAL OPTIONS

Downlight Output	CCT and CRI	Downlight Option	Voltage	Circuiting
◯ S - Standard ◯ B - Boosted Standard ◯ H - High ◯ V - Very High ◯ TL - Tailored: _____ lm/ft * * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.	◯ 830 - 80 CRI min, 3000K ◯ 835 - 80 CRI min, 3500K ◯ 840 - 80 CRI min, 4000K ◯ 930 - 90 CRI min, 3000K ◯ 935 - 90 CRI min, 3500K ◯ 940 - 90 CRI min, 4000K ◯ 8TW - 80 CRI min, Tunable White ◯ 9TW - 90 CRI min, Tunable White	⦿ F - Flush	◯ 120 - 120 Voltage ◯ 277 - 277 Voltage ◯ 347 - 347 Voltage	◯ SC - Single Circuit* One single circuit in a run ◯ MC - Multi Circuit* More than one switch leg or zone (not 'DC' indepedent control of up and down separately for an I/D style fixture). Factory shop drawings required *Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS / MOUNTING OPTIONS

Driver Selection	Ceiling Hardware Type
0-10V Driver Options ◯ FC-10% - 0-10V 10% (standard) [2] ◯ FC-1% - 0-10V 1% [2] ◯ OSR-10% - Osram OTi, 0-10V 10% ◯ OSR-1% - Osram OTi, 0-10V 1% [2] ◯ ELD-10V - EldoLED SOLOdrive, 0-10V 0.1% ◯ 10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [2] **DALI Driver Options** ◯ FC-DALI - DALI 1% ◯ OSR-DALI - Osram Dexal, 1% ◯ ELD-DALI - EldoLED SOLOdrive, DALI 0.1% ◯ DALI-TW - EldoLED Dual Drive Light Shape, 1% *(Tunable White)* **DMX Driver Options** ◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTUNE Controls Only)* ◯ DMX - EldoLED POWERdrive, 0.1% ◯ DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)* **Lutron Driver Options** ◯ LUT-ES1 - Lutron, Ecosystem 1% ◯ LUT-2W - Lutron, 2-wire (120v only) 1% ◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)* See Page 3 for additional driver options and details	◯ C1 - 1" T-Bar ◯ C2 - 9/16" T-Bar ◯ C3 - Screw Slot ◯ SF - Spackle Flange

OTHER OPTIONS

Endcap Style	Finish	Emergency Style (Optional) Clear Selection	Integrated Sensor (Optional) Clear Selection	Special Options (Optional) Clear Selection
⦿ FE - Flat Endcap	◯ SW - Signal White ◯ FB - Finelite Black ◯ SA - Satin Aluminum ◯ #### - RAL Color Code [4] _____	◯ LGD18W - Legrand 18W Brand Battery Back-up ◯ LGD10W - Legrand 10W Brand Battery Back-up ◯ EM/GEN - Emergency to Generator ◯ NL - Night Light ◯ BSL310LP - Bodine Battery Back up Low Profile ◯ GTD - Generator Transfer Device ◯ ALCR - Automatic Load Control Relay	◯ OBO - Occupancy ◯ OBD - Daylight ◯ W601 - Wattstopper [5] Wireless Sensor ◯ OBE - Enlighted [6]	◯ CP - Chicago Plenum ◯ RLA - Red List Approved ◯ RLD - Declare

1 Contact factory for switching options
2 Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
3 B & V outputs only
4 20 Business day lead time for color
5 LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected.
LMFS-601 w/ Dali driver, only 1 driver can be connected.
6 Enlighted components installed by Finelite; Provided by other

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TWDTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120v only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system, plug-together wiring, standard.

LENGTHS: Any length, 2' minimum section length. Increments of 1'. 12' maximum section length.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). A separate chart summarizes lumen distribution and wattage. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION: 12' maximum diffuser length. Flush (**F**) frost white snap-in diffuser, standard; 73% transmissive, 99% diffusion

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

ELECTRICAL OPTIONS

STATIC WHITE FEED: 18-gauge/5-conductor single-circuit feed wire, standard. 14-gauge feed wire used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10% - 100%. Dimming to 1% available; Consult factory. Driver is fully accessible from below the ceiling.

- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS:

- **LUTES1** Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series)
- **LUTES5** 5-Series 5% EcoSystem (LDE5 Series)
- **LUT2W** Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series);

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V/277V.

- **Power factor** ≥0.9
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100 - 1%
- **Expected driver lifetime:** 100,000 hours

LUTRON TUNABLE WHITE DRIVER OPTION: LUTDTW 1% T-Series 2-Channel Digital Tunable White (PSQ Series).

MOUNTING TYPE

HANGING HARDWARE:

- **Recessed Spackle Flange:** Drywal surfaces (walls or ceilings): 1/4" - 20 stud and nut (provided by others). Mounted with three equidistant suspension points.
- **Recessed T-Bar:** Standard bracket design works with most lay-in ceiling types. Brackets secure luminaire to the ceiling grid from above. Tie-in T-Bar brackets connect the luminaire to the T-Bar for securing to structure. Consult local codes for tie-wire recommendations.

OTHER OPTIONS

ENDCAPS: Flat endcaps (**FE**) at each end of run add 1/16" to each end of luminaire.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery

	Legrand 18W	Legrand 10W/ Bodine BSL310LP
HPX-R-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	2024	1202
EM Section Illuminated	2'	2' or 4'

* Minimum fixture housing length for battery pack approved without sensor
** Exception: 5' not available, 6'+ okay.

TUNABLE WHITE ELECTRICAL OPTIONS:

- **TW Driver Options 0-10V:** EM/GEN, GTD, or Battery Back-up
- **FineTune DMX:** EM/GEN or Battery Back-up
- **DMX:** Battery Back-up
- **DALI:** EM/GEN, GTD, or Battery Back-up
- **LUTRON:** EM/GEN, GTD, or Battery Back-up

Bodine GTD and Legrand ALCR Min. Length

Configuration	Min Length
Generator	4'
Generator + OCC	6'
Daylight	4'
Generator + Daylight	6'

Continued

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

SPECIFICATIONS

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options.

FINISHES: Finelite Signal White (**SW**) powder coat standard. Finelite Black (RAL 9005) with semi gloss fine texture (**FB**) [1] and satin Aluminum (**SA**) [1] are available. Optional Adders: 185 RAL colors. [1]

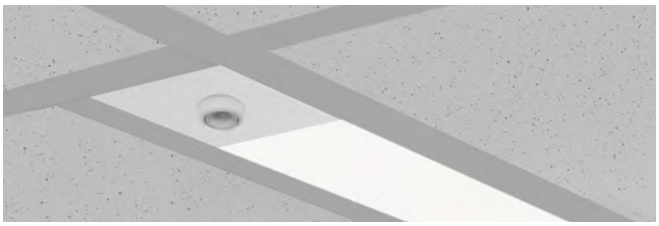
LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request, contact factory for more details. These fixtures are rated for Damp Location. IC Rated. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. HPX can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT: 2.3 lb/ft.

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

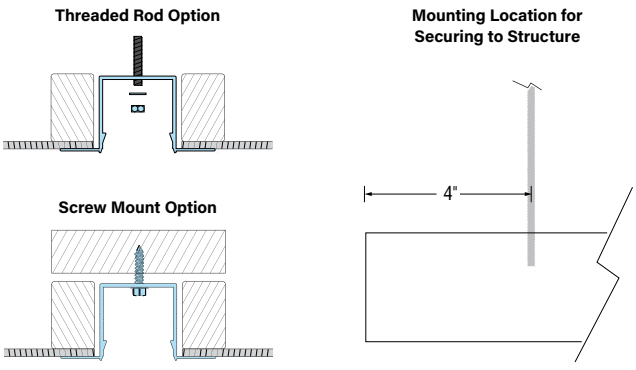
[1] 20 business day lead time for color

INTEGRATED SENSOR



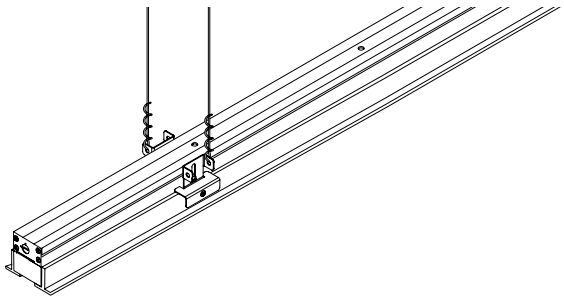
Integrated PIR (Passive Infrared) occupancy or daylight sensors available with Flush and Bottom Glow downlight diffusers. Refer to Occupancy Sensor and Daylight Sensor tech sheets for more info.

HARD CEILING MOUNTING OPTIONS



Two mounting options: threaded rod and screw mounting options. Mounting locations are located on each end of the luminaire. Mounting location is 4" away from each end of luminaire

T-BAR INSTALLATION



HPX-R for T-Bar installations comes standard with a splice plate at the end of the luminaire. Mounting brackets (supplied) secure the luminaire to T-Bar and provide support to structure location. All even foot length (2, 4, 6...) luminaire runs are reduced in length an appropriate amount to fit within typical 2×2 and 2×4 T-Bar grid systems. For uncommon T-Bar systems please consult factory.

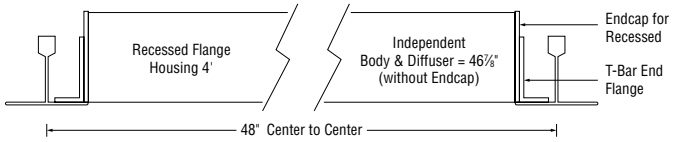
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

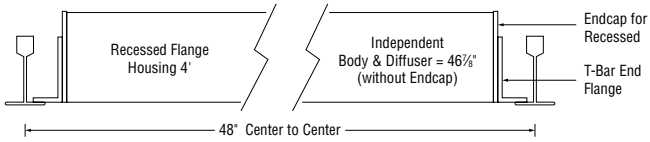
High Performance 2.5" Aperture (HPX) Recessed

GRID LENGTH DETAIL - 4' EXAMPLE

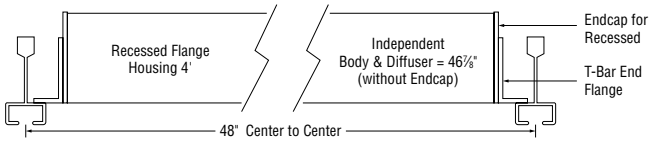
1" T-Bar



9/16" T-Bar

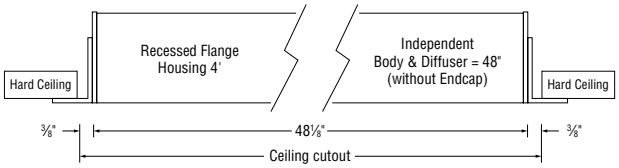


9/16" Screw Slot



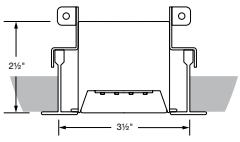
HARD CEILING LENGTH DETAIL - 4' EXAMPLE

Spackle Flange

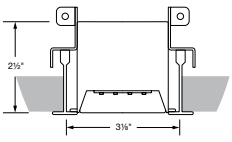


RECESSED MOUNTING TYPES T-BAR

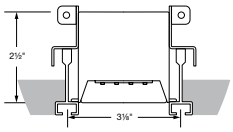
Rough-In Dimensions



1" T-Bar (C1)

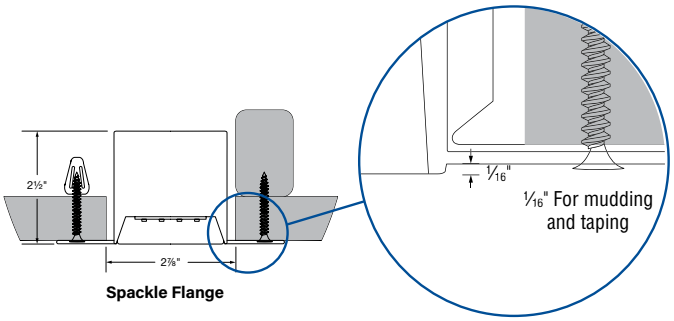


9/16" T-Bar (C2)



Standard Screw Slot (C3)

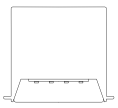
RECESSED MOUNTING TYPES CUTOUT DIMENSIONS



Spackle Flange

HOUSING

Version 3



Ceiling Options C1, C2, C3

Version 4

Ceiling Option SF

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

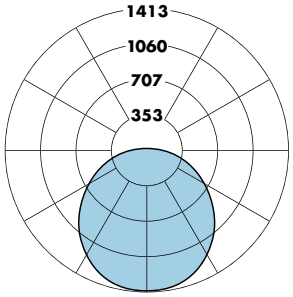
High Performance 2.5" Aperture (HPX) Recessed

Recessed Photometry

4' Luminaire 3500k

HPX-R-D-V-835-F

Efficacy: 124 lm/W
Total luminaire output: 4127 lumens (1032 lumens/ft)
33.2 watts (8.3 watts/ft)
Peak Candela Value: 1413 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 93256



CANDLEPOWER SUMMARY

	0.0	22.5	45.0	67.5	90.0	Flux
0	1413	1413	1413	1413	1413	
5	1409	1407	1408	1408	1407	134
15	1363	1354	1360	1361	1358	383
25	1267	1253	1264	1264	1261	581
35	1127	1116	1126	1123	1119	702
45	951	945	950	946	944	731
55	746	743	747	743	741	665
65	520	521	523	522	522	517
75	292	295	298	299	300	315
85	89	88	91	91	91	100
90	0	0	0	0	0	

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaure			
S[1]	**B[1]**	**H[1]**	**V[2]**
1689	2124	3210	4127

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S[1]	**B[1]**	**H[1]**	**V[2]**
422	531	802	1032

Power, 3500K, CRI (Watts Per Foot)			
S[1]	**B[1]**	**H[1]**	**V[2]**
3.2	4.1	6.4	8.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S[1]	**B[1]**	**H[1]**	**V[2]**
130	129	126	124

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 3210 lm x 0.789 = 2533 lm

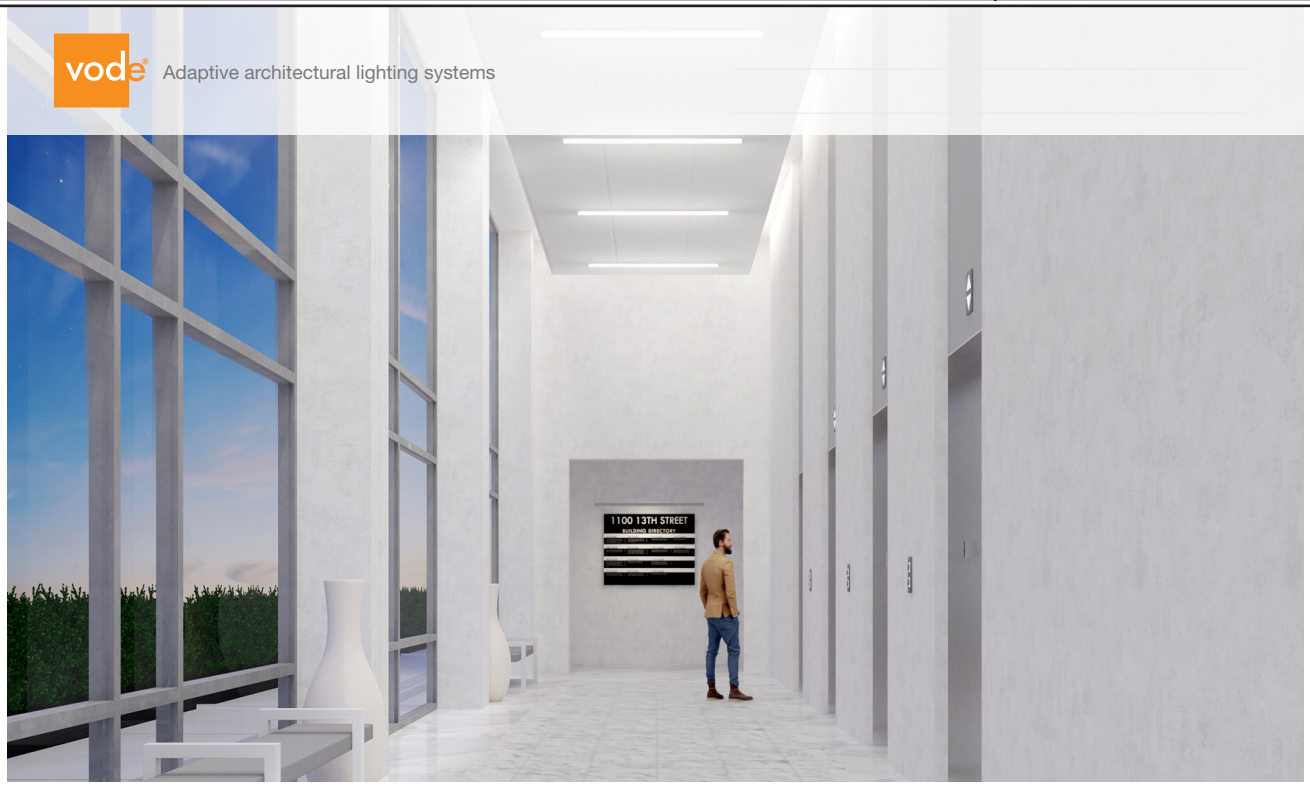
Total Light Output per Foot: 802 lm x 0.789 = 633 lm

watts/foot: 6.4 W/ft.

Efficacy = $\frac{633 \ \frac{\text{lm}}{\text{ft.}}}{6.4 \ \frac{\text{W}}{\text{ft.}}}$ = 99 lm/W

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 93256

NOT USED



Spec Guide

ZipTwo® | Square 3535 | 707

Direct lighting for open office and ambient applications.

Square 3535, Critical Edge, white

Benefits & Features

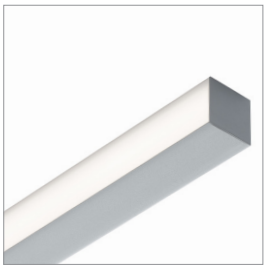
Low Profile Design
Square profile. 1.38" (35mm) x 1.42" (36mm).

Superior Light Quality & Performance
Output up to 1316 lm/ft (4318 lm/m) (HO), 135 lm/W (SO). 80 or 90 CRI & tunable white (2200K-5000K) available.

Versatile Mounting, Easy Installation
Magnet with tape-on metal strip or low profile clip allow for mounting to almost any surface or T-Bar ceiling.

Extensive Optics
Options of Diffuse, Critical Edge, and Side Diffuse give designers the power to create and design their space using one product.

Square 3535, Diffuse, white



Square 3535, Side Diffuse, white

Build Your Specification

707-Z2	SL				0

System & Rail Type
707-Z2 ZipTwo

System Type
SL Standard Linear

System Length
Specify overall system length in ft/in or M/mm.

Corner and Shapes Available ***See Guide*** *for details*

Rail Length
24 24" (610mm)
36 36" (914mm)
48 48" (1219mm)
60 60" (1524mm)
72 72" (1829mm)
96 96" (2438mm)
108 108" (2743mm)
120 120" (3048mm)
132 132" (3352mm)
144 144" (3658mm)
ZZ Other rail length or layout (please specify)

See ***Rail Length Chart*** *for more details*

Mounting
C Clip
CM Clip with Micro J-Box
T Magnet with Tape-On Metal Strip
T1 9/16" T-Bar Clip, low profile
T2 15/16" T-Bar Clip, low profile
T3 15/16" T-Bar Clip, medium profile
T4 15/16" T-Bar Clip, concealed
T5 9/16" T-Bar Clip, medium profile
T6 Slotted T-Bar Clip
T7 Dimensional T-Bar Clip
SC Strut Channel Clip
DM Armstrong DynaMax
ZZ Other (please specify)

Arm/Cord Length
0 None

RP				Z

Power Location
Remote Power

RP25 25' (7.62m) Wire Harness
RP50 50' (15.24m) Wire Harness
RP75 75' (22.86m) Wire Harness
RP100 100' (30.48m) Wire Harness

Power Type
Flexible 1 to 1 Power
AE eldoLED 0-10v, 1.0% Dimming
AT eldoLED 0-10v, 0.1% Dimming
AD eldoLED DALI, 0.1% Dimming
AX eldoLED DMX, 100-0% Dimming
AH Hi-lume 1% EcoSystem, Soft On / Fade to Black Technology, LDE1
AH2 Hi-lume 1% 2-wire LTEA2W (120V forward phase only)

Optomized Power
AEO eldoLED 0-10v, 1.0% Dimming
ATO eldoLED 0-10v, 0.1% Dimming
ADO eldoLED DALI, 0.1% Dimming
AXO eldoLED DMX,100-0% dimming

ZZ Other (please specify)

See* ***Power Guide* *for driver features & limitations.*

Voltage
1 120v
2 120v-277v
X Not Yet Specified

Emergency Power
0 No Emergency Power
ZZ Emergency Power *(specify requirements)*

LED Type
Z Zipper Board™

Lumen Output
LO Low Output
SO Standard Output
HO High Output*
ZZ Other (please specify)

See ***IES Files*** *page for details.*
See* ***Power Guide* *for driver features & limitations.*

Color Temperature
80+ CRI
27 2700K
30 3000K
35 3500K
40 4000K

90+ CRI
279 2700K
309 3000K
359 3500K
409 4000K

ZZ Tunable White Available ***See Guide*** for details

Optics
S5 Square 3535, Critical Edge
S6 Square 3535, Diffuse
S9 Square 3535, Side Diffuse
SA Square 3535, Single Side Diffuse

Sensors
0 None
ZZ Other (please specify)[1]

Finish
WH White
BL Black

Options
0 None
9 9' 18/3 Cord and Plug
CP Contact factory for Chicago Plenum

NOTES & LIMITATIONS
[1] *Sensors are available please contact* ***Vode*** *for more information.*

5 Year Limited Warranty. See full Vode warranty description ***here*** *or at vode.com.*

Listed to UL standards for damp location by a Nationally Recognized Testing Laboratory (NRTL) recognized by OSHA.

ZipTwo® | Square 3535 | 707 Spec Guide

Structure

Rail Lengths	*24" (610mm) - 144" (3658mm) See **Rail Length Chart** for more details.*
Rail Dimensions	1.38" (35mm) x 1.42" (36mm). See dimensions section for details
Construction	Extruded and machined 6063 aluminum.
Mounting	Clip, Clip with Micro J-Box, Magnet with Tape-On Metal Strip, T-Bar Clips for most grid/panel construction, Strut Channel Clip.
Run Length	24" (610mm) minimum. Rail lengths may be installed end-to-end to any length.
Operating Temperature	32°F to 104°F (0°C to 40°C).
Humidity	0-95%, non-condensing. Suitable for damp locations.
System Weight	0.25lbs per ft (0.11kg per 305mm). *Power supply and housing not included.*

Materials

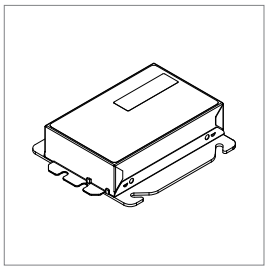
LED Board Construction	Aluminum core PCB, black LCP connectors, RoHS compliant.
Lens	High-impact extruded acrylic glass (PMMA).
Power Cable	Ø3mm, 33/2 AWG, Plenum (CMP) rated semi-rigid PVC or FEP, flame tested UL-910 *(PVC free in 2020)*
Cable Connectors	Unfilled black nylon, rated UL 94 V-0, halogen free, PVC or FEP overmold, RoHS compliant *(PVC free in 2020)*
Remote Linear Power Housing (RLP)	20.7" x 2.375" x 2.53", 0.054" formed Galvanized Steel
Remote Brick Power Housing (RBP)	4.32" x 3.37" x .078" Galvanized Steel mounting plate

Power and Controls

Power Type	Class 2 (<60v output) constant current driver
Dimming Controls	Dimming (0.1%, 1%), 0-10v, DALI, DMX, Lutron Hi-lume 1% are available. *See **Power Guide** for details.*
Input Voltage	120v - 277v, 50/60hz
Power Location	Remote power. Maximum remote distance up to 100' (30.5m) *depending* on driver selection. *See **Power Guide** for details.*

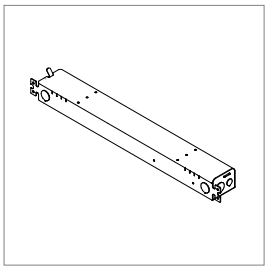
Remote power is locating the power supply away from the fixture. Remote power comes in two housing styles: brick style and linear style. Consult ***Power Guide*** to determine which type you will receive.

Remote Brick Power Housing



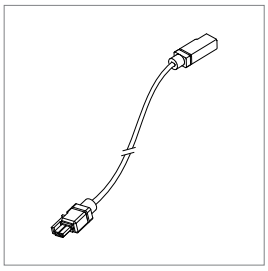
Supplied for some remote power applications. One remote power supply housing is supplied for each rail. Provided driver mounting plate fits standard 4" metal, square J-Boxes with a minimum volume of 21 in^3 (J-Box not provided).
See ***Tech Sheet*** for details.

Remote Linear Power Housing



One remote power supply housing is supplied with each power supply. All Vode linear remote drivers come in a 0.054" (0.8mm) formed galvanized steel power supply housing with five (5) knockouts: (4) 1-1/8", (1) 7/8" and (1) 9/16". Accommodates standard linear power supplies.
See ***Tech Sheet*** for details.

Wire Harness

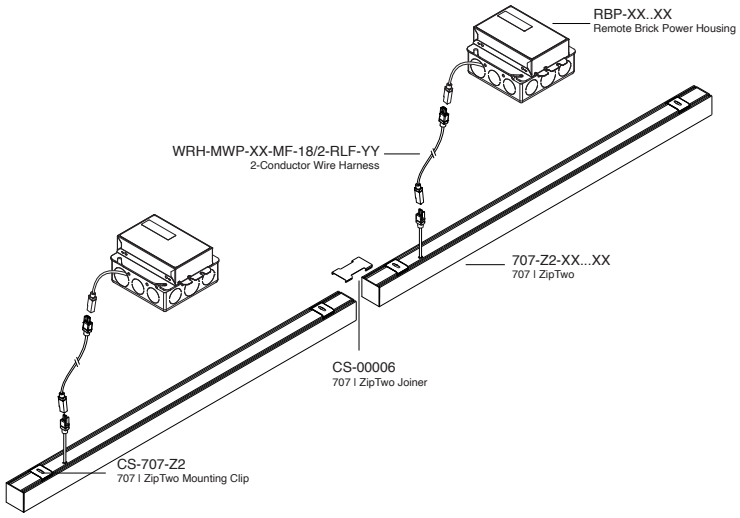


Wire harness connects driver to rail. Wire hareness is 25' (7.6m) with micro fit molex connectors for quick and easy installation. Multiple harnesses can be combined for a total length of up to 100' (30.5m).
See ***Tech Sheet*** for details.

Power and Controls

Flexible 1 to 1 power

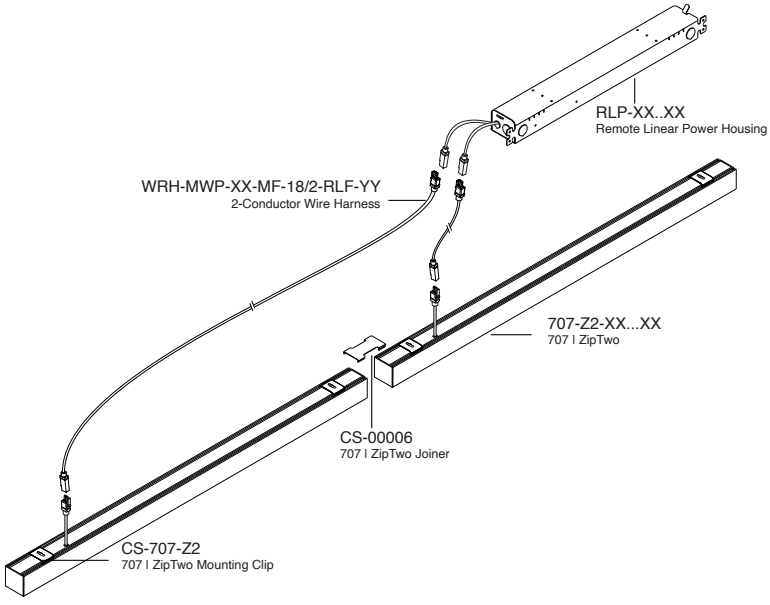
For Flexible 1 to 1 Power, Vode supplies one single output driver per fixture, allowing each fixture to be controlled independently. Direct/Indirect fixtures are supplied with two single output drivers, allowing the direct and indirect lighting to be controlled independently. Consult ***Power Guide*** to determine which type you will receive.



Optimized Power

To optimize power, Vode configures specifications with drivers that have 2 or 4 outputs. Depending on system configurations and power requirements, up to 4 fixtures can be powered from a 4-output driver. Consult ***Power Guide*** to determine which type you will receive.

IMPORTANT: Each fixture will still require individual wire harnesses, as shown below.

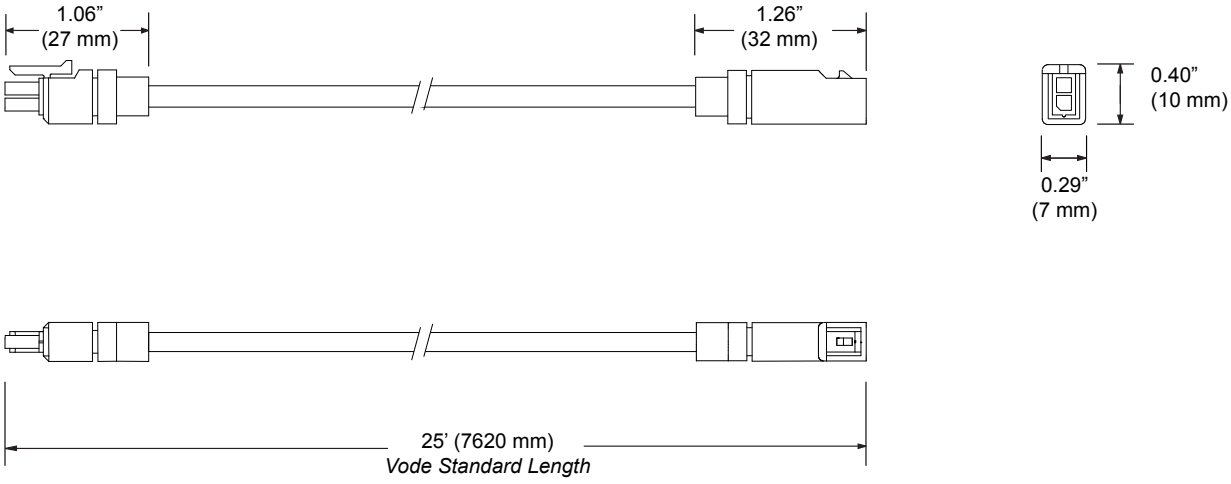


Note: Drawings not to scale, for reference only.

Power and Controls

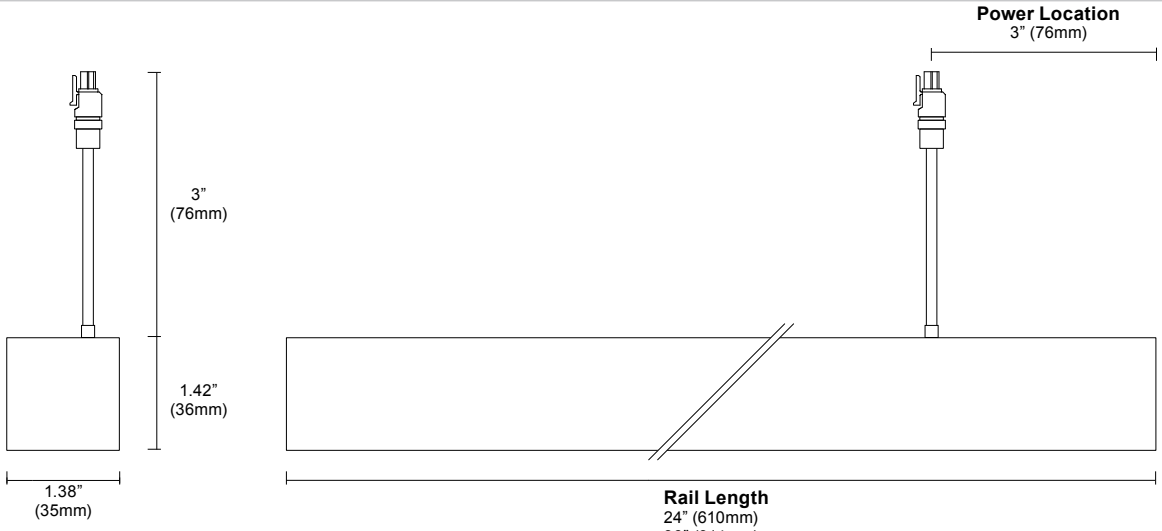
Wire Harness

Low voltage wire harness connects driver to rail. Wire hareness is 25' (7.6m) 18/2 AWG stranded wire with provided micro fit molex connectors on either end for quick and easy installation. Multiple haresses can be combined for a total length of up to 100' (30.5m). Refer to Vode Power Guide for max remote distance based on power selection. Consult ***Power Guide*** to determine which type you will receive.



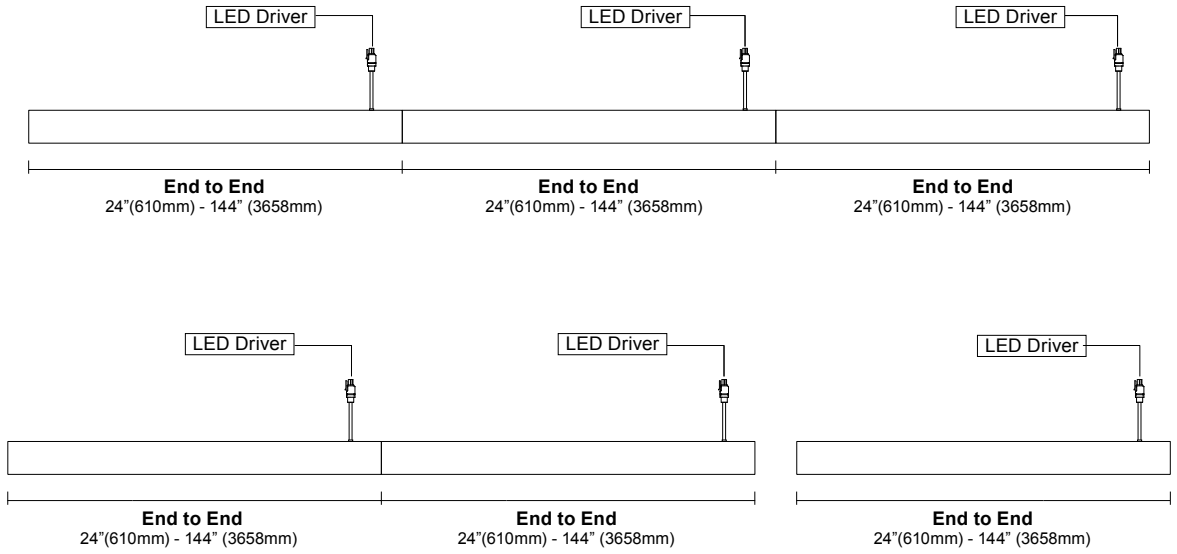
Note: Drawings not to scale, for reference only.

Dimensions



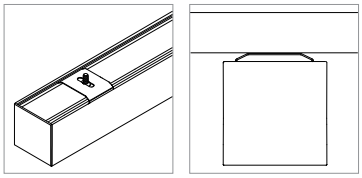
Rail Length
24" (610mm)
36" (914mm)
48" (1219mm)
60" (1524mm)
72" (1829mm)
96" (2438mm)
108" (2743mm)
120" (3048mm)
132" (3352mm)
144" (3658mm)

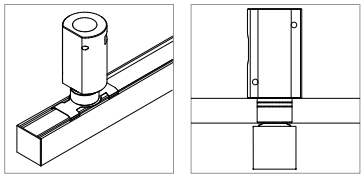
Layout

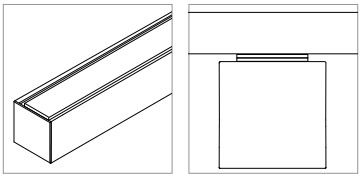


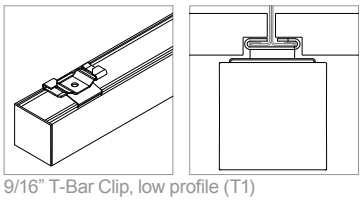
Corner and Shapes Available (Square, Rectangle, L-Shape, U-Shape, ZigZag)
See Guide for details

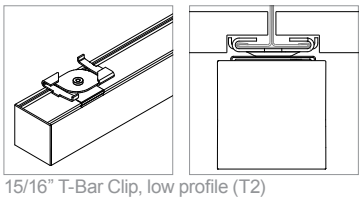
Mounting Options

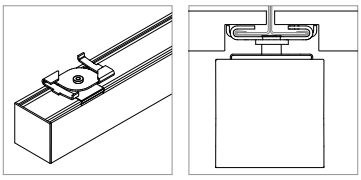

Clip (C)

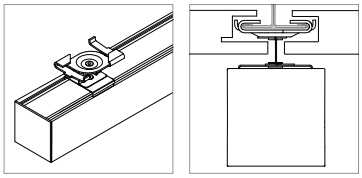

Clip with Micro J-Box (CM)

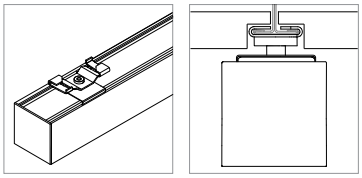

Magnet with Tape-On Metal Strip (T)

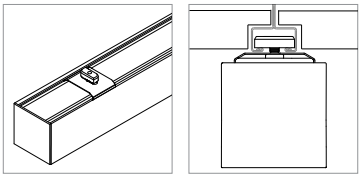

9/16" T-Bar Clip, low profile (T1)

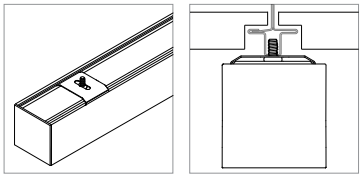

15/16" T-Bar Clip, low profile (T2)

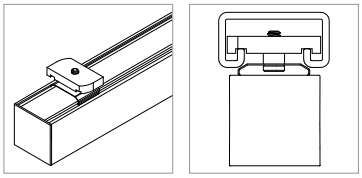

15/16" T-Bar Clip, medium profile (T3)

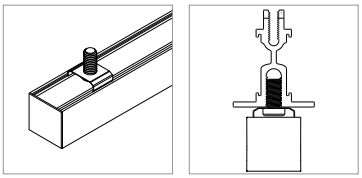

15/16" T-Bar Clip, concealed (T4)


9/16" T-Bar Clip, medium profile (T5)


Slotted T-Bar Clip (T6)


Dimensional T-Bar Clip (T7)


Strut Channel Clip (SC)

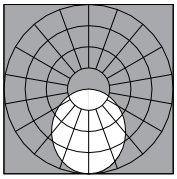
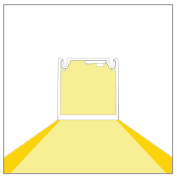

Armstrong DynaMax (DM)

See ***ZipTwo Clip Guide*** to check compatibility.

Performance | Zipper LED

Zipper Board has 72 diodes per foot (305mm). Testing based on a 4' rail section. Lumen measurement complies with IES-LM-79-08 testing procedures.

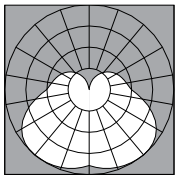
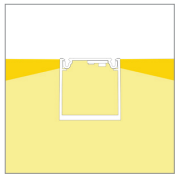
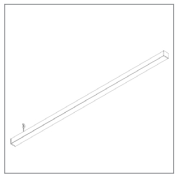
Square 3535, Critical Edge (S5)


L80 >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	64	66	67	67	55	57	58	58
Lumens per foot (305mm)	235	243	248	248	203	209	214	216
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	73	75	76	76	63	65	66	67
Lumens per foot (305mm)	471	486	496	496	406	419	427	432
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	72	74	76	76	62	64	65	66
Lumens per foot (305mm)	706	729	744	744	609	628	641	647
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

Square 3535, Diffuse (S6)

L80 >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	127	131	134	134	110	113	115	117
Lumens per foot (305mm)	471	486	496	496	406	419	428	432
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	145	150	153	153	125	129	132	133
Lumens per foot (305mm)	943	973	992	992	813	838	856	864
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	144	148	151	151	124	128	130	132
Lumens per foot (305mm)	1414	1459	1489	1489	1219	1258	1283	1296
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

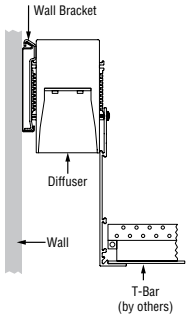
HP-2 WS Perimeter Slot provides ultimate flexibility for perimeter lighting with exact fit tailored lengths or optional adjustable telescoping sections. Prebuilt, fully-illuminated 90° inside and outside corners add to its clean aesthetics. HP-2 WS Perimeter Slot delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components. An all-in-one box shipping approach to reduce labor and streamline installation.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving Red List Approved and Declared status.

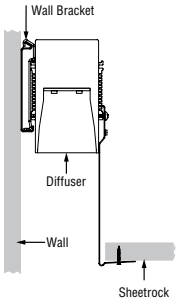
Note: see page 6 for all aesthetic options

CROSS SECTIONS

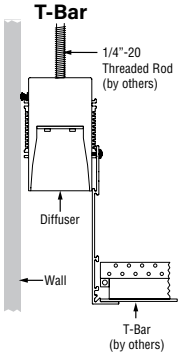
Wall Mount T-Bar



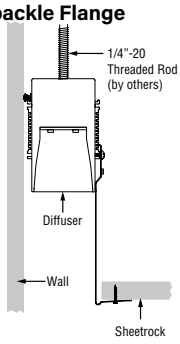
Wall Mount Spackle Flange



Threaded Rod T-Bar

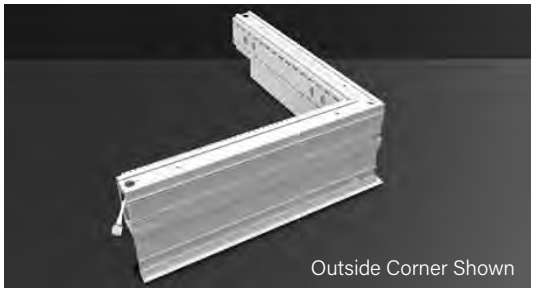


Threaded Rod Spackle Flange

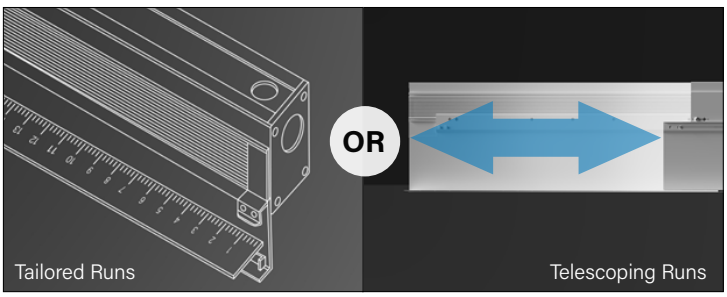


FEATURES

Fully illuminated, factory built all-in-one box shipping plug-together inside and outside corners for easy installation.



Provide exact wall dimensions and we will deliver precisely down to 1/16" or optional adjustable telescoping (**TXL**) sections adaptable to on-site dimension.



INDUSTRY BEST 10 YEAR LED WARRANTY

Fine TUNE GENERATION 1 Option Available

Declare. Third Party Verified

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

Clear Form

Ordering Sample: HP-2 WS-4D-24'-B-835-96LG-277-SC-FC-10%-WB-C1-FE-L-FE-R-SW

BODY TYPE

Platform	Series Name	Regressed Optic Depth	Total Length of Run
◉ HP - High Performance	◉ 2 WS	◉ 4D - 4" Depth	For configurations provide nominal total length. Actual length calculated by factory. Please provide drawings to clearly illustrate corners and wall dimensions _____ **Tailored Runs:** Minimum 2' section length. Increments accurate to 1/16" (±1/32), standard. 12' maximum section length. **TXL Runs:** Optional TXL adds 1" to run length and up to an additional 11" of fully illuminated adjustability. Minimum length with TXL: 4'-1" with Std. Osram drivers or 5'-1" with all other drivers. Max single section length with TXL adjustable from 11'-1" to 12'-0".

OUTPUT AND LED TYPE

Downlight Output	LED CRI/CCT
○ S - Standard (326 lm/ft) ○ B - Boosted Standard (410 lm/ft) ○ H - High (619 lm/ft) ○ V - Very High (796 lm/ft) ○ TL - Tailored:_____lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.	○ 830 - 80 CRI, 3000K ○ 835 - 80 CRI, 3500K ○ 840 - 80 CRI, 4000K ○ 930 - 90 CRI, 3000K ○ 935 - 90 CRI, 3500K ○ 940 - 90 CRI, 4000K ○ 8TW - 80 CRI, Tunable White ○ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Reflector System	Voltage	Circuiting[1]
○ 96LG - 96 Low Gloss White	○ 120 - 120 Voltage ○ 277 - 277 Voltage ○ 347 - 347 Voltage	○ SC - Single Circuit* One single circuit in a run ○ MC - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required * Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS

Driver Selection

0-10V Driver Options
- ○ FC-10% - 0-10V 10%[2] (standard)
- ○ FC-1% - 0-10V 1%[2]
- ○ OSR-10% - Osram OTi, 0-10V 10%[2]
- ○ OSR-1% - Osram OTi, 0-10V 1%[2]
- ○ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%
- ○ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)*[2]

DALI Driver Options
- ○ FC-DALI-1% - DALI 1%
- ○ OSR-DALI-1% - Osram Dexal, 1%
- ○ ELD-DALI-0% - EldoLED SOLOdrive, 0.1%
- ○ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*

DMX Driver Options
- ○ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)*[3]
- ○ ELD-DMX - EldoLED POWERdrive, 0.1%
- ○ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options
- ○ LUT-ES1 - Lutron, Ecosystem 1%
- ○ LUT-2W - Lutron, 2-wire (120V only) 1%
- ○ LUT-TW - Lutron T-Series, 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method	Ceiling Hardware Type *
○ TR - Threaded Rod Ideal for Post-Ceiling installation ○ WB - Wall Bracket Ideal for Pre-Ceiling installation	○ C1 - 1" T-Bar ○ C2 - 9/16" T-Bar ○ C3 - Screw Slot ○ SF - Spackle Flange ○ C1T - 1" Tegular ○ C2T - 9/16" Tegular * Compatible with all T-Bar type. T-Bar width provided is 15/16" wide.

OTHER OPTIONS

End Condition Left[4]	Middle Condition[4] (Optional)	End Condition Right[4]	Finish
◉ FE-L - Flat Endcap (standard) ○ PE-L - Pocket Slot ○ TXL-L* - Telescoping (End feed only) ○ PE-TXL-L* - Pocket Slot Telescoping	○ TXL-M* - Telescoping Middle (Not available for lengths less than 11ft) ○ None - None	◉ FE-R - Flat Endcap (standard) ○ PE-R - Pocket Slot ○ TXL-R* - Telescoping (End feed only) ○ PE-TXL-R* - Pocket Slot Telescoping	◉ SW - Signal White (standard)

* Just one optional TXL provides fully illuminated adjustability of up to 11". Choose TXL-L(Left), TXL-M (Middle), or TXL-R(Right).

OTHER OPTIONS

Emergency Style (Optional) Clear Selection	Remote Sensor (Optional) Clear Selection	Special Options (Optional) Clear Selection	Configuration Clear Selection
○ LGD18W - Legrand 18W Brand Battery Back-up ○ LGD10W - Legrand 10W Brand Battery Back-up ○ EM/GEN - Emergency to Generator ○ NL - Night Light ○ BSL310LP - Bodine Battery Back up Low Profile ○ GTD - Generator Transfer Device ○ ALCR - Automatic Load Control Relay	○ REE - Remote Enlighted[5,6]	○ CP - Chicago Plenum ○ FLX - Flex Whip ○ RLA - Red List Approved ○ RLD - Declared	○ CFG - Configuration Select CFG when specifying a run that has at least one corner. Please provide plan drawings to clearly communicate wall length dimensions.

[1] Contact factory for switching options
[2] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[3] B & V outputs only
[4] Telescoping can be Left, Middle, or Right. Left, Middle, and Right telescoping on the same body section is not available, consult factory if needed.
[5] Enlighted components installed by Finelite, provided by others
[6] Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming (LDE1)
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming (LTEA2W)
LUT-TW	Lutron T-Series, 0.1% Dimming, *Tunable White* (PSQ02U)

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Telescoping (**TXL**) Minimum run length with Std. Osram drivers: 4'-1" adjustable to 5'-0". Telescoping (**TXL**) Minimum run length with all other drivers: 5'-1" adjustable to 6'-0". Max single section length with TXL adjustable from 11'-1" to 12'-0". Just one optional TXL provides fully illuminated adjustability of up to 11". Choose TXL-L(Left), TXL-M (Middle), or TXL-R(Right).

PRE-BUILT 90 DEGREE CORNERS [1]: Fully illuminated 90 degree inside and outside corners available. Pre-built corners account for 2' of wall length for both inside and outside corners. Consult factory for non-90 degree corners.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION : 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 83% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint.

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed wire controlling downlight (power and dimming). 14-gauge feed wire used when luminaire current exceeds 5 amps. Telescoping section available with end feed only.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:
- **LUT-ES1 (LDE1)** (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series)) (LDE1)
- **LUT-2W (LTES2W)** (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)) (LTEA2W)

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime:** 100,000 hours
- FineTune DMX is 1%

LUTRON TUNABLE WHITE DRIVER OPTION:
LUT-TW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)). (PSQ02U)

MOUNTING OPTIONS

HANGING HARDWARE: Threaded Rod (TR) option eliminates the need to install luminaires prior to the slot be- ing framed. Luminaire mounts on threaded rods. Gasket runs length of luminaire ensuring a clean finish at the wall. Optional mounting includes a wall bracket that is attached to the wall. Luminaires are then snapped onto the bracket. Luminaire installation that uses the mounting bracket must be performed before the perimeter slot framing is built. Blocking may be required to properly secure and position the luminaire. Be sure to allow room for finished wall materials such as stone, tile etc. Refer to details on page 7.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of luminaire runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

SPECIFICATIONS

OTHER OPTIONS

END CONDITIONS: Flat end condition (**FE-L & FE-R**)[1] at each end of run add 1/8" to each end of luminaire and are used when luminaire terminates at a vertical surface such as a finished wall. Pocket slot end condition (**PE-L & PE-R**)[1] to end and are used when slot terminates before meeting additional vertical wall surface. Includes the necessary hardware to accommodate ceiling materials when the luminaire doesn't terminate at a wall. Adds 1-1/4" for Spackle Flange and 1" for T-Bar per endcap to overall length of the luminaire.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery				
	Legrand 10W		Bodine BSL310LP 4ft. & 6ft.+ is okay. 4.1~5.9 not okay.	
Min. Housing Length	8'*	10'* + TXL	4'*	6'* + TXL
EM Lumen Output	1608	1608	956	956
EM Section Illuminated	2'	2'	2' or 4'	2' or 4'

* Minimum luminaire housing length for battery pack approved without sensor

TUNABLE WHITE ELECTRICAL OPTIONS[6]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

REMOTE SENSORS: Remote mounted PIR (Passive Infrared) occupancy or daylight sensors available. Refer to Occupancy Sensor, Daylight Sensor, and Enlighted Sensor tech sheets for more info.

FINISHES: Finelite Signal White (**SW**) powder coat finish standard. Optional Adder: 185 RAL colors[2] are available. Custom color applies to the visible T-Bar flange.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These luminaires are rated for Damp Location. IC Rated. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT[8]: Wall Mount T-Bar: 4.6 lb/ft; Wall Mount SF: 4.4 lb/ft; Threaded-Rod T-Bar: 3.1 lb/ft; Threaded-Rod SF: 2.9 lb/ft

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

[1] Minimum 3' body section length when using standard Finelite Osram drivers.
Minimum 4' body section length when using other drivers
[2] 20 business days lead time for color

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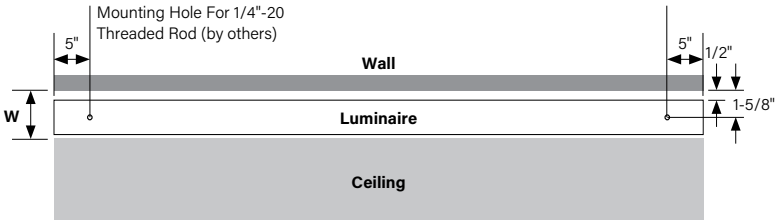
FINELITE® Better Lighting

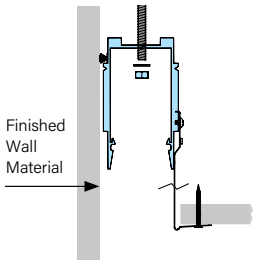
High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

THREADED-ROD (TR) MOUNTING LOCATION

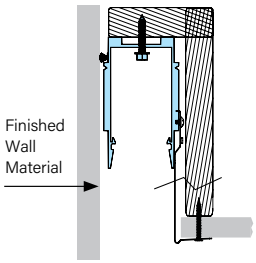


W (Rough-In): Spackle Flange & T-Bar: 3-1/8"

MOUNTING OPTIONS

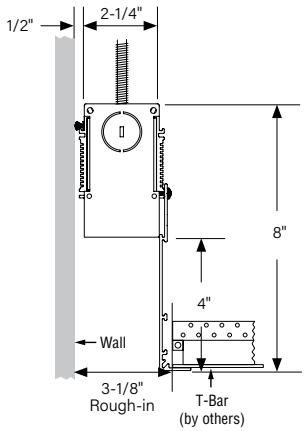


1/4"-20 Threaded Rod
(by others)

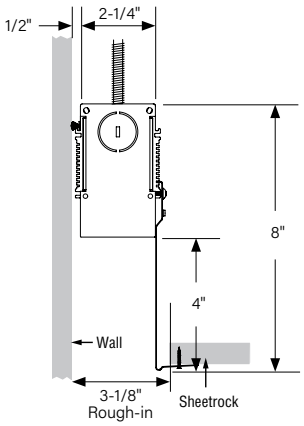


Screw Mount Option
(by others)

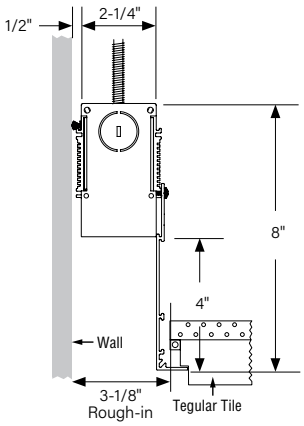
THREADED-ROD (TR) MOUNTING CROSS SECTIONS



(C1, C2, C3)



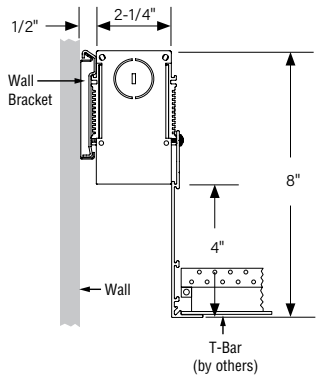
(SF)



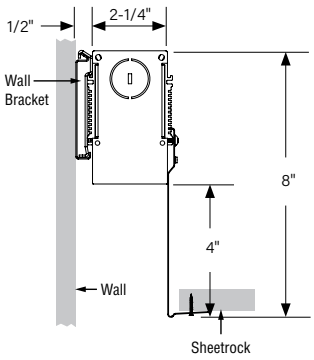
(C1T, C2T)

Note: Use blocking to allow room for finished wall materials such as stone, tile etc.

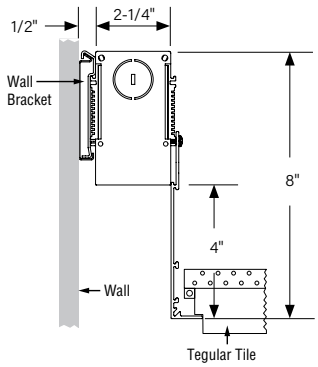
WALL BRACKET (WB) MOUNTING CROSS SECTIONS



(C1, C2, C3)



(SF)



(C1T, C2T)

Note: Use blocking to allow room for finished wall materials such as stone, tile etc.

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Ordering Info:		

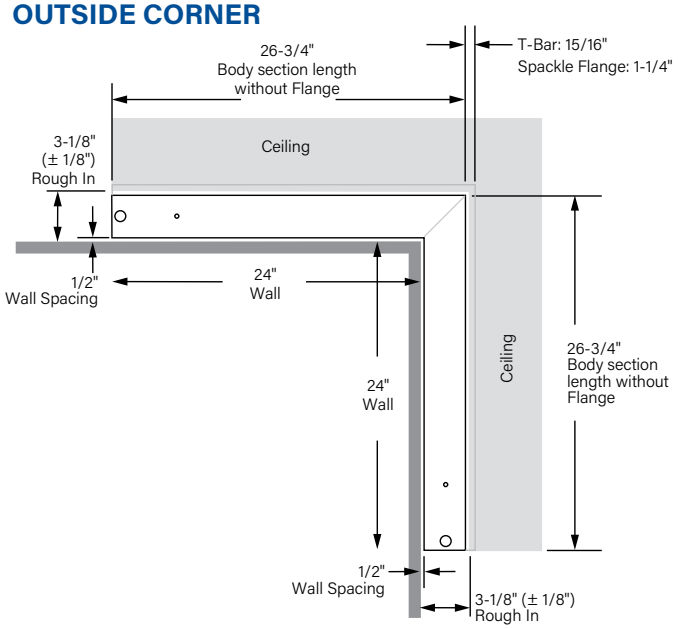
FINELITE® Better Lighting

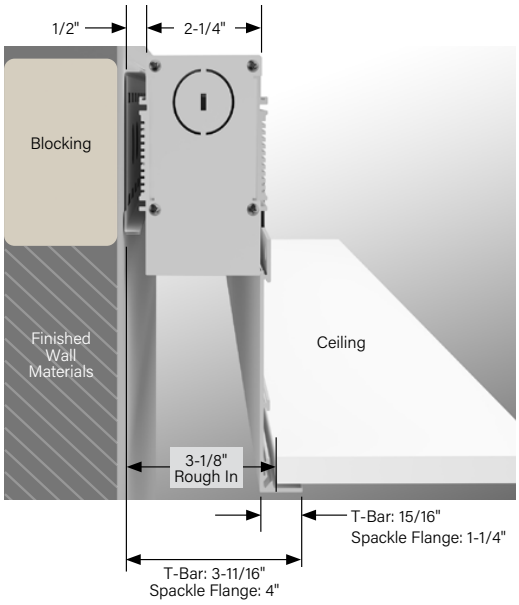
High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

PRE-BUILT 90º INSIDE AND OUTSIDE FULLY ILLUMINATED CORNERS

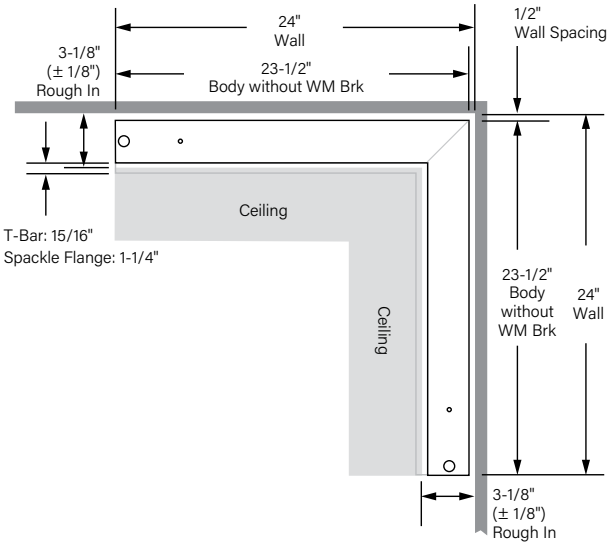
Pre-built inside and outside 90º corners provide fully illuminated corners. Mitered joints are pre-assembled in the factory for easy installation in the field. As shown in the example below, inside and outside corners take up 2ft of wall length to simplify the calculation of remaining run length.

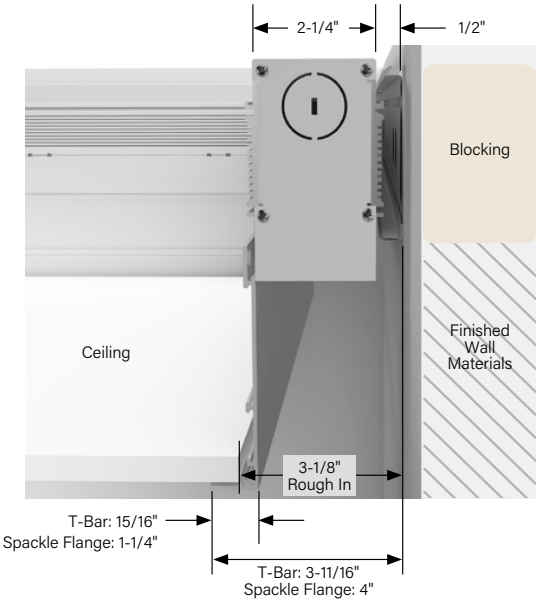
OUTSIDE CORNER





INSIDE CORNER





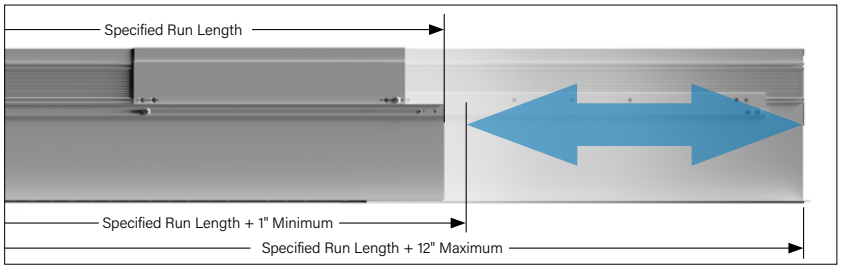
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

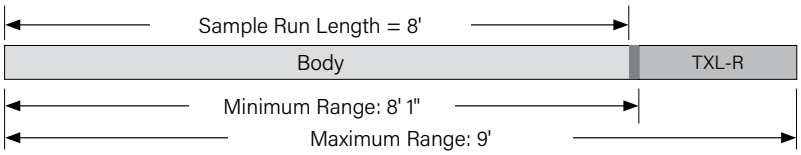
High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

TELESCOPING

One telescoping (**TXL**) provides on-site flexibility with up to 11" of adjustability. and can be specified on either end of a run. Telescope adds a minimum of 1" and maximum of 12" to the run length provided. Max single section length with TXL adjustable from 11'-1" to 12'-0". Offered with flat endcap (standard) or pocketslot endcap.

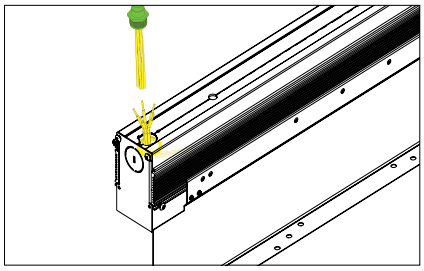


SF WM Telescoping Shown

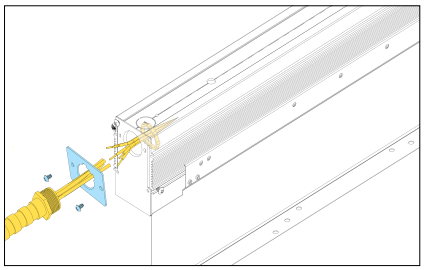


Ordering Sample: HP-2 WS-4D-8'-B-835-96LG-277-SC-FC-10%-WB-C1-FE-L-TXL-R-SW

POWER FEED



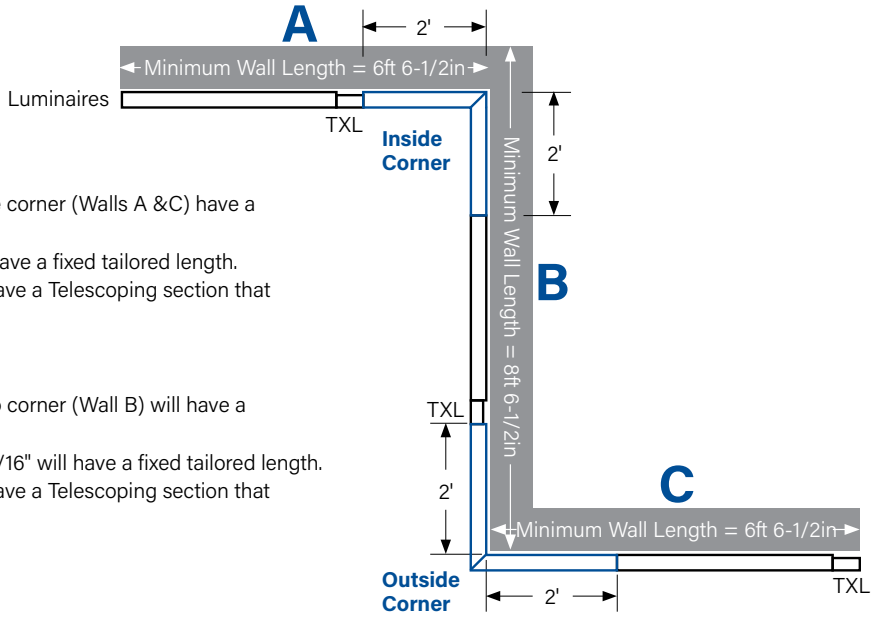
Top feed is standard. Top feed not available on a section with telescoping



End feed options

CONFIGURATIONS WITH PRE-BUILT CORNERS AND TELESCOPING

The example below demonstrates the target minimum wall length requirements for a configuration with pre-built 90 degree corners and telescoping. Consult factory for applications that require shorter than minimum lengths than shown below.



For configurations, wall segments with **One** corner (Walls A &C) have a minimum wall length of 4'.
- Wall lenghts between 4' to 6' 6-7/16" will have a fixed tailored length.
- Wall lengths of 6' 6-1/2" and greater will have a Telescoping section that provides +/- 5-1/2" of adjustability

For configurations, wall segments with **Two** corner (Wall B) will have a minimum wall length of 6'.
- Wall lengths between between 6' to 8' 6-7/16" will have a fixed tailored length.
- Wall lengths of 8' 6-1/2" and greater will have a Telescoping section that provides +/- 5-1/2" of adjustability

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Type:	Project:
Ordering Info:	

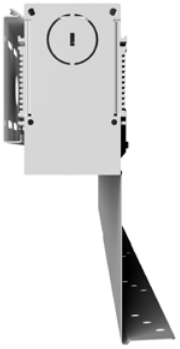
FINELITE® Better Lighting

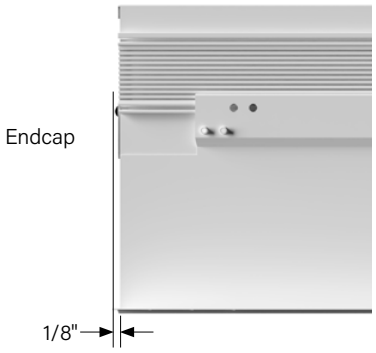
High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

ENDCAP OPTIONS

Endcap Information
The **Flat Endcap** adds 1/8" per endcap to the section length.
The **Pocket Slot Endcap** adds 1-1/4" for Spackle Flange and 1" for T-Bar per endcap to the section length.
Example: Overall Luminaire Length = Luminaire Section + Endcap + Endcap
11' - 3-1/2" = 11' - 3-1/4" + 1/8" + 1/8"

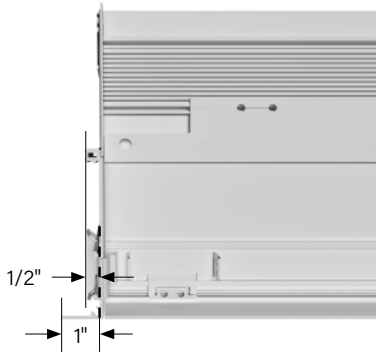
Standard Flat (FE-L or FE-R)
Add 1/8" per endcap to the section length. Spackle Flange version shown T-Bar available. Flat end condition for when luminaire terminates at a vertical surface such as a finished wall.



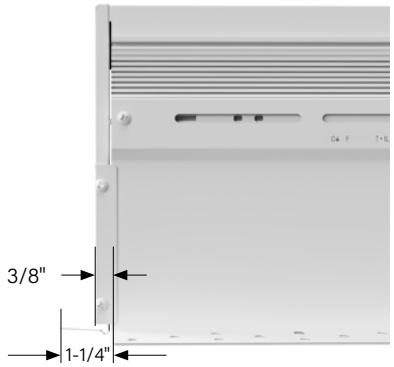


Pocket Slot (PE-L or PE-R)
Adds 1-1/4" for Spackle Flange and 1" for T-Bar (includes endcap dimension 1/8") per endcap to the housing length on shop drawings T-Bar version shown, Spackle Flange available.

T-Bar



Spackle Flange



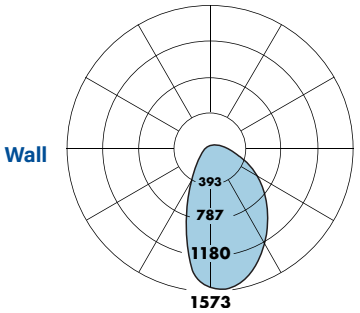
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

Recessed Photometry - 4' Luminaire 3500K

HP-2 WS-4D-4'-V-835
Efficacy: 90 lm/W
Total luminaire output: 3184 lumens (796 lm/ft)
35.4 watts (8.9 W/ft)
Peak Candela Value: 1552 @ 5º
CRI: 80 / CCT: 3500K
ITL LM79 Report 94264



CANDELA DISTRIBUTION

	0.0	22.5	45	67.5	90	Flux
0	1479	1479	1479	1479	1479	
5	1552	1527	1468	1418	1367	138
15	1547	1527	1396	1011	762	356
25	1407	1409	1255	530	190	458
35	1217	1226	1066	136	0	475
45	1027	1020	854	17	0	456
55	845	816	636	13	0	401
65	668	618	424	8	0	326
75	503	434	221	4	0	233
85	354	273	56	1	0	140
90	289	207	2	0	0	
95	265	181	0	0	0	87
105	198	120	0	0	0	58
115	135	71	0	0	0	34
125	81	34	0	0	0	17
135	39	9	0	0	0	6
145	8	0	0	0	0	1
155	0	0	0	0	0	0
165	0	0	0	0	0	0
175	0	0	0	0	0	0
180	0	0	0	0	0	

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B** [1]	**H** [1]	**V** [2]
1303	1639	2476	3184

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
326	410	619	796

Power, 3500K (Watts Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
3.5	4.4	6.8	8.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B** [1]	**H** [1]	**V** [2]
94	93	91	90

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 2476 lm x 0.789 = 1954 lm

Total Light Output per Foot: 619 lm/ft x 0.789 = 488 lm/ft.

watts/foot: 6.8 W/ft.

$$\textbf{Efficacy} = \frac{488\ \frac{\text{lm}}{\text{ft.}}}{6.8\ \frac{\text{W}}{\text{ft.}}} = 72\ \text{lm/W}$$

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 94264

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

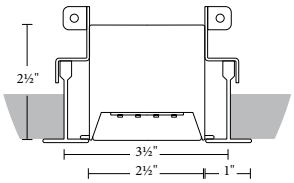
High Performance 2.5" Aperture (HPX) Recessed

The High Performance 2.5" Aperture (HPX) is a patented LED linear luminaire with a square micro profile and internal driver design. This Line-of-Light luminaire delivers excellent performance and is equipped with a unique LED configuration for superior illumination. HPX can be tailored from 2' to 12' sections in 1' increments and is available in Pendant, Surface Mount, and Recessed.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

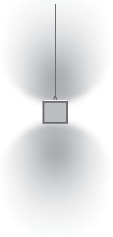
CROSS SECTIONS

Recessed



Flush Downlight Diffuser
(standard)

ALSO AVAILABLE IN



Pendant
(**ID, D**)

Surface Mount
(**SM**)

LUMEN OUTPUT PACKAGES

S	B	H	V
Standard	Boosted Standard	High	Very High

PERFORMANCE

Up to **2057** **Lumens** per **Foot**

Up to **125** **Lumens** per **Watt**

Option Available

Protected by one or more US Patents: 8915613; 9681516,B2; D702,390

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

Clear Form

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Run Length of Configuration
◉ **HP** - High Performance	◉ **X** - 2.5" Square	◉ **R** - Recessed	◉ **D** - Direct	_____ Minimum 2' section length. Increments of 1'; 12' maximum section length

OUTPUT AND LED TYPE

Downlight Output	CCT and CRI
◯ **S** - Standard ◯ **B** - Boosted Standard ◯ **H** - High ◯ **V** - Very High ◯ **TL** - Tailored: _____ lm/ft * * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.	◯ **830** - 80 CRI min, 3000K ◯ **835** - 80 CRI min, 3500K ◯ **840** - 80 CRI min, 4000K ◯ **930** - 90 CRI min, 3000K ◯ **935** - 90 CRI min, 3500K ◯ **940** - 90 CRI min, 4000K ◯ **8TW** - 80 CRI min, Tunable White ◯ **9TW** - 90 CRI min, Tunable White

MECHANICAL/ OPTICAL OPTIONS

Downlight Option
◉ **F** - Flush

ELECTRICAL OPTIONS

Voltage	Circuiting
◯ **120** - 120 Voltage ◯ **277** - 277 Voltage ◯ **347** - 347 Voltage	◯ **SC** - Single Circuit* One single circuit in a run ◯ **MC** - Multi Circuit* More than one switch leg or zone (not 'DC' indepedent control of up and down separately for an I/D style fixture). Factory shop drawings required *Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS

Driver Selection

0-10V Driver Options
- ◯ **FC-10%** - 0-10V 10% (standard) [2]
- ◯ **FC-1%** - 0-10V 1% [2]
- ◯ **OSR-10%** - Osram OTi, 0-10V 10%
- ◯ **OSR-1%** - Osram OTi, 0-10V 1% [2]
- ◯ **ELD-10V** - EldoLED SOLOdrive, 0-10V 0.1%
- ◯ **10V-TW** - Osram OTi, 0-10V 10% *(Tunable White)* [2]

DALI Driver Options
- ◯ **FC-DALI** - DALI 1%
- ◯ **OSR-DALI** - Osram Dexal, 1%
- ◯ **ELD-DALI** - EldoLED SOLOdrive, DALI 0.1%
- ◯ **DALI-TW** - EldoLED Dual Drive Light Shape, 1% *(Tunable White)*

DMX Driver Options
- ◯ **FIN-DMX** - Finelite DMX 1% *(Tunable White - FineTUNE Controls Only)*
- ◯ **DMX** - EldoLED POWERdrive, 0.1%
- ◯ **DMX-TW** - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options
- ◯ **LUT-ES1** - Lutron, Ecosystem 1%
- ◯ **LUT-2W** - Lutron, 2-wire (120v only) 1%
- ◯ **LUT-TW** - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Ceiling Hardware Type
- ◯ **C1** - 1" T-Bar
- ◯ **C2** - 9/16" T-Bar
- ◯ **C3** - Screw Slot
- ◯ **SF** - Spackle Flange

OTHER OPTIONS

Endcap Style
- ◉ **FE** - Flat Endcap

Finish
- ◯ **SW** - Signal White
- ◯ **FB** - Finelite Black
- ◯ **SA** - Satin Aluminum
- ◯ **####** - RAL Color Code [4]
  _____

Emergency Style (Optional) — Clear Selection
- ◯ **LGD18W** - Legrand 18W Brand Battery Back-up
- ◯ **LGD10W** - Legrand 10W Brand Battery Back-up
- ◯ **EM/GEN** - Emergency to Generator
- ◯ **NL** - Night Light
- ◯ **BSL310LP** - Bodine Battery Back up Low Profile
- ◯ **GTD** - Generator Transfer Device
- ◯ **ALCR** - Automatic Load Control Relay

Integrated Sensor (Optional) — Clear Selection
- ◯ **OBO** - Occupancy
- ◯ **OBD** - Daylight
- ◯ **W601** - Wattstopper [5] Wireless Sensor
- ◯ **OBE** - Enlighted [6]

Special Options (Optional) — Clear Selection
- ◯ **CP** - Chicago Plenum
- ◯ **RLA** - Red List Approved
- ◯ **RLD** - Declare

1 Contact factory for switching options
2 Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
3 B & V outputs only
4 20 Business day lead time for color
5 LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected.
LMFS-601 w/ Dali driver, only 1 driver can be connected.
6 Enlighted components installed by Finelite; Provided by other

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TWDTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120v only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system, plug-together wiring, standard.

LENGTHS: Any length, 2' minimum section length. Increments of 1'. 12' maximum section length.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). A separate chart summarizes lumen distribution and wattage. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION: 12' maximum diffuser length. Flush (**F**) frost white snap-in diffuser, standard; 73% transmissive, 99% diffusion

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

ELECTRICAL OPTIONS

STATIC WHITE FEED: 18-gauge/5-conductor single-circuit feed wire, standard. 14-gauge feed wire used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10% - 100%. Dimming to 1% available; Consult factory. Driver is fully accessible from below the ceiling.

- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS:

- **LUTES1** Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series)
- **LUTES5** 5-Series 5% EcoSystem (LDE5 Series)
- **LUT2W** Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series);

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V/277V.

- **Power factor** ≥0.9
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100 - 1%
- **Expected driver lifetime:** 100,000 hours

LUTRON TUNABLE WHITE DRIVER OPTION: LUTDTW 1% T-Series 2-Channel Digital Tunable White (PSQ Series).

MOUNTING TYPE

HANGING HARDWARE:

- **Recessed Spackle Flange:** Drywal surfaces (walls or ceilings): 1/4" - 20 stud and nut (provided by others). Mounted with three equidistant suspension points.
- **Recessed T-Bar:** Standard bracket design works with most lay-in ceiling types. Brackets secure luminaire to the ceiling grid from above. Tie-in T-Bar brackets connect the luminaire to the T-Bar for securing to structure. Consult local codes for tie-wire recommendations.

OTHER OPTIONS

ENDCAPS: Flat endcaps (**FE**) at each end of run add 1/16" to each end of luminaire.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery

	Legrand 18W	Legrand 10W/ Bodine BSL310LP
HPX-R-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	2024	1202
EM Section Illuminated	2'	2' or 4'

* Minimum fixture housing length for battery pack approved without sensor
** Exception: 5' not available, 6'+ okay.

TUNABLE WHITE ELECTRICAL OPTIONS:

- **TW Driver Options 0-10V:** EM/GEN, GTD, or Battery Back-up
- **FineTune DMX:** EM/GEN or Battery Back-up
- **DMX:** Battery Back-up
- **DALI:** EM/GEN, GTD, or Battery Back-up
- **LUTRON:** EM/GEN, GTD, or Battery Back-up

Bodine GTD and Legrand ALCR Min. Length

Configuration	Min Length
Generator	4'
Generator + OCC	6'
Daylight	4'
Generator + Daylight	6'

Continued

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

SPECIFICATIONS

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options.

FINISHES: Finelite Signal White (**SW**) powder coat standard. Finelite Black (RAL 9005) with semi gloss fine texture (**FB**) [1] and satin Aluminum (**SA**) [1] are available. Optional Adders: 185 RAL colors. [1]

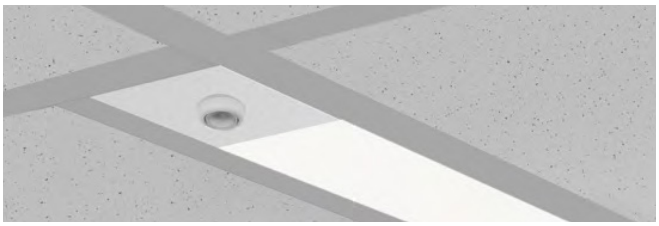
LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request, contact factory for more details. These fixtures are rated for Damp Location. IC Rated. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. HPX can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT: 2.3 lb/ft.

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

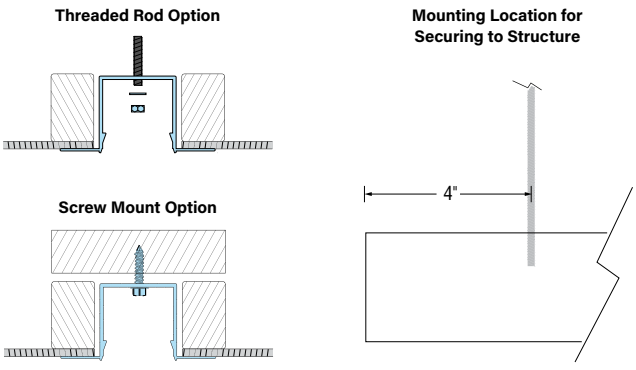
[1] 20 business day lead time for color

INTEGRATED SENSOR



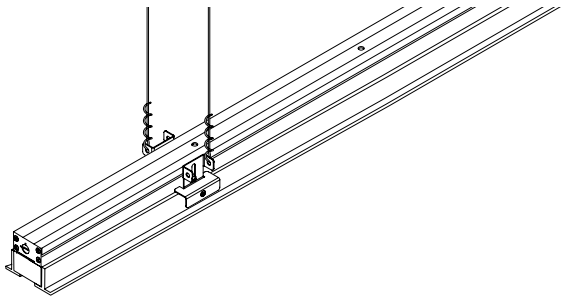
Integrated PIR (Passive Infrared) occupancy or daylight sensors available with Flush and Bottom Glow downlight diffusers. Refer to Occupancy Sensor and Daylight Sensor tech sheets for more info.

HARD CEILING MOUNTING OPTIONS



Two mounting options: threaded rod and screw mounting options. Mounting locations are located on each end of the luminaire. Mounting location is 4" away from each end of luminaire

T-BAR INSTALLATION



HPX-R for T-Bar installations comes standard with a splice plate at the end of the luminaire. Mounting brackets (supplied) secure the luminaire to T-Bar and provide support to structure location. All even foot length (2, 4, 6...) luminaire runs are reduced in length an appropriate amount to fit within typical 2×2 and 2×4 T-Bar grid systems. For uncommon T-Bar systems please consult factory.

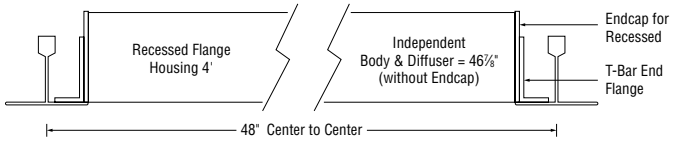
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

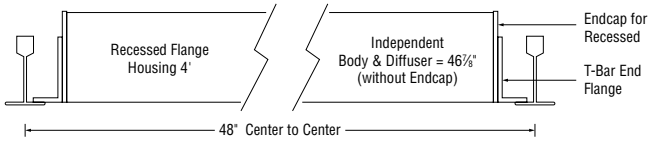
High Performance 2.5" Aperture (HPX) Recessed

GRID LENGTH DETAIL - 4' EXAMPLE

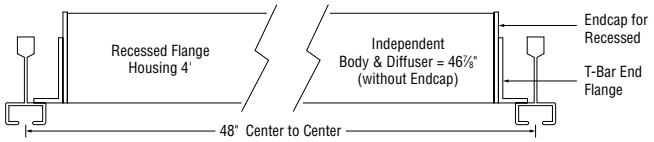
1" T-Bar



9/16" T-Bar

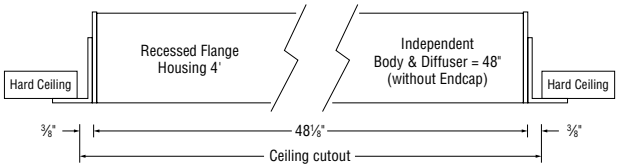


9/16" Screw Slot



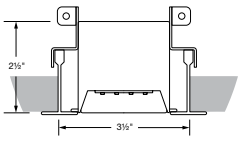
HARD CEILING LENGTH DETAIL - 4' EXAMPLE

Spackle Flange

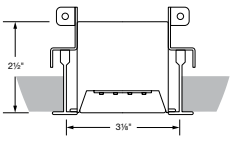


RECESSED MOUNTING TYPES T-BAR

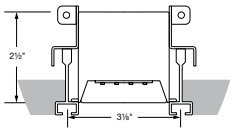
Rough-In Dimensions



1" T-Bar (C1)

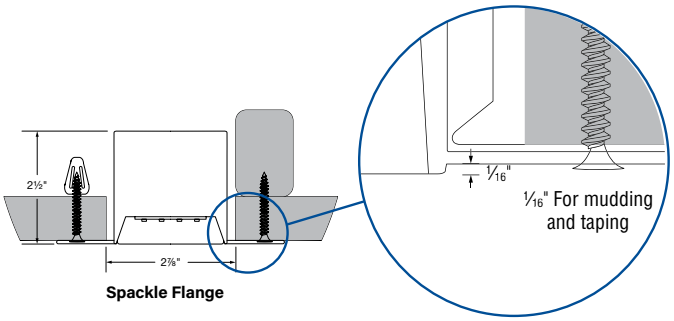


9/16" T-Bar (C2)



Standard Screw Slot (C3)

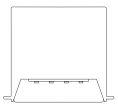
RECESSED MOUNTING TYPES CUTOUT DIMENSIONS



Spackle Flange

HOUSING

Version 3



Ceiling Options C1, C2, C3

Version 4

Ceiling Option SF

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

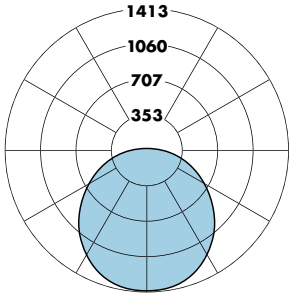
High Performance 2.5" Aperture (HPX) Recessed

Recessed Photometry

4' Luminaire 3500k

HPX-R-D-V-835-F

Efficacy: 124 lm/W
Total luminaire output: 4127 lumens (1032 lumens/ft)
33.2 watts (8.3 watts/ft)
Peak Candela Value: 1413 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 93256



CANDLEPOWER SUMMARY

	0.0	22.5	45.0	67.5	90.0	Flux
0	1413	1413	1413	1413	1413	
5	1409	1407	1408	1408	1407	134
15	1363	1354	1360	1361	1358	383
25	1267	1253	1264	1264	1261	581
35	1127	1116	1126	1123	1119	702
45	951	945	950	946	944	731
55	746	743	747	743	741	665
65	520	521	523	522	522	517
75	292	295	298	299	300	315
85	89	88	91	91	91	100
90	0	0	0	0	0	

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaure			
S[1]	**B[1]**	**H[1]**	**V[2]**
1689	2124	3210	4127

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S[1]	**B[1]**	**H[1]**	**V[2]**
422	531	802	1032

Power, 3500K, CRI (Watts Per Foot)			
S[1]	**B[1]**	**H[1]**	**V[2]**
3.2	4.1	6.4	8.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S[1]	**B[1]**	**H[1]**	**V[2]**
130	129	126	124

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 3210 lm x 0.789 = 2533 lm

Total Light Output per Foot: 802 lm x 0.789 = 633 lm

watts/foot: 6.4 W/ft.

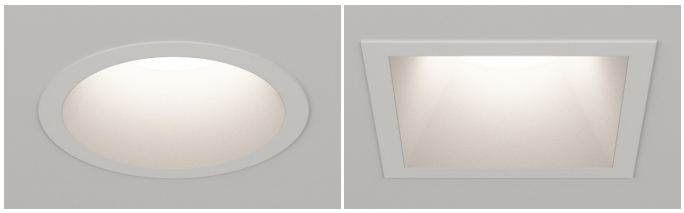
Efficacy = $\frac{633 \ \frac{\text{lm}}{\text{ft.}}}{6.4 \ \frac{\text{W}}{\text{ft.}}}$ = 99 lm/W

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 93256

FRAXION®3 SLIM

FIXED

PROJECT NAME:	TYPE:



Lots of light in an under-the-radar profile, with multiple design and installation options, ideal for corporate offices and retail settings.

ORDERING INFORMATION - DOWNLIGHT / HOUSING

JA8-2019 INDICATED BY SHADING

SHAPE	TRIM	RATING	TYPE		FLANGE FINISH	BAFFLE FINISH		LUMEN PACKAGE	CCT	OPTIC	INSTALL TYPE	CEILING THICKNESS		DRIVER	EFFECTS DEVICE
			F	-			-						-		
F3R Round F3S Square	M Microflange T Trimless Drywall W Trimless Wood* *(Not available for Wet location)	1 Dry/Damp 2 Wet* *(Requires provided suction cup to service or aim & focus)	F Fixed		WH White BK Black PR Primer AU Cashmere Gold AG Satin Silver BB Burnt Bronze 00 Trimless* *(Required for trimless) CF Custom Finish* *(Consult Factory)	WH White BK Black PR Primer AU Cashmere Gold AG Satin Silver BB Burnt Bronze CF Custom Finish* *(Consult Factory)		STATIC WHITE 80C12A 80+ CRI Dlvd. Lumens - 795 80C16A 80+ CRI Dlvd. Lumens - 1095 80C23A 80+ CRI Dlvd. Lumens - 1506 90C10A 90+ CRI Dlvd. Lumens - 683 90C14A 90+ CRI Dlvd. Lumens - 936 90C19A 90+ CRI Dlvd. Lumens - 1291 97C10A 97+ CRI Dlvd. Lumens - 608 97C12A 97+ CRI Dlvd. Lumens - 833 97C17A 97+ CRI Dlvd. Lumens - 1151* *(Not available for IC housings) WARM DIM 90W11A 90+ CRI Dlvd. Lumens - 857 Incandescent Profile 90W13A 90+ CRI Dlvd. Lumens - 902 Halogen Profile *SEE PAGE 3 FOR DETAILED WARM DIM PROFILE COMPARISON. TUNABLE WHITE 90T12A 90+ CRI Dlvd. Lumens -950* *(Only available for remote housings) *ALL DELIVERED LUMEN OUTPUTS AND T24 COMPLIANCE REFLECT 3000K PAIRED WITH 40° OPTIC AND SOFT FOCUS LENS. REFERENCE PAGE 3 FOR ADDITIONAL T24 COMPLIANT CONFIGURATIONS.	22 2200K* *(Only available with 90C10A and 90C14A) 27 2700K 30 3000K 35 3500K 40 4000K WL 2700K - 1800K WD 3200K - 1800K TW 5000K - 2700K	10 10°* *(Only available with 80C12A, 90C10A and 97C10A. Not available with 2200K) 15 15° 22 22° 40 40° 60 60° 85 85°* *(Uses 60° optic and optional configuration 14 (WDL) to achieve 85° beam spread) 15 15° 22 22° 40 40° 60 60° 85 85°* *(Uses 60° optic and optional configuration 14 (WDL) to achieve 85° beam spread) 22 22° 40 40° 60 60° 85 85°* *(Uses 60° optic and optional configuration 14 (WDL) to achieve 85° beam spread)	INTEGRAL DRIVER X IC Y NIC C IC, Airtight* *(Chicago Plenum, Airtight & Title 24 compliant housing) REMOTE DRIVER V IC, Remote W NIC, Remote D IC, Airtight, Remote* *(Chicago Plenum, Airtight & Title 24 compliant housing)	1 0.50" - 1.375" 2 1.375" - 2.125" T 0.50" - 1.375"* *(Includes adjustable housing height bracket, recommended for any T-Grid or Furring Channel applications)	INTEGRAL PH ELV/Triac, 2% 120V* *(Not available for 80C12A, 90C10A, and 97C10A unless 10° degree optic is specified) SG 0-10V Analog, LOG 1% 120 or 277V SN 0-10V Analog, LIN 1% 120 or 277V LP Lutron, Hi-Lume Premier Ecosystem 0.1% Fade to Black, 120 or 277V* *(Not available for 80C23A, 90C19A, or 97C17A in all IC install types) REMOTE (120V) L2 Lutron, Hi-Lume 1% 2-wire REMOTE (120-277V) EG eldoLED, SOLOdrive 0.1% 0-10V, LOG EN eldoLED, SOLOdrive 0.1% 0-10V, LIN ED eldoLED, SOLOdrive 0.1% DALI, LOG TUNABLE WHITE REMOTE (120-277V) DG eldoLED, DUALdrive 0.1% 0-10V, LOG DN eldoLED, DUALdrive 0.1% 0-10V, LIN DD eldoLED, DUALdrive 0.1% DALI, LOG	STANDARD EFFECTS DEVICE 04 Soft Focus Lens NL No Lens* *(Standard and only available with 10° optic. Not available for Wet Location or Airtight Housings) ALTERNATE EFFECTS DEVICE 02 Honeycomb Louver* *(Not available for Wet location, Warm Dim or Airtight Housings) 03 Clear Glass Lens* *(Not available for Warm Dim) 05 Frosted Glass Lens 08 Frosted Soft Focus Lens 14 Wide Distribution Lens* *(Required and only available for 85° beam spread) 26 Frosted Linear Spread Lens

(WH) White Powder Coat

(BK) Black Powder Coat

(AU) Cashmere Gold Powder Coat

(AG) Satin Silver Powder Coat

(BB) Burnt Bronze Powder Coat

PART NUMBER NOTES

- Housing and trim ship as e.g., F3RM1F-WHWH-90C10A2-3X1-PH*
- Remote driver ships with fixture as e.g., PSF3-RMT-90C-10A-1L2*

[PH] +1-210-227-7329
[FAX] +1-210-227-4967

FRAXION3 SLIM FIXED

ACCESSORIES

ROUND ALTERNATE EFFECTS DEVICES
Dry / Damp location only
Wet location requires alternate baffle.

- ☐ **HCL-F3R** Honeycomb Louver w/ Diffusion Lens*
  *(Not available for Warm Dim, Wet locations, or Airtight Housings)
- ☐ **CGL-F3R** Clear Glass Lens*
  *(Not available for Warm Dim)
- ☐ **FGL-F3R** Frosted Glass Lens
- ☐ **SFL-F3R** Soft Focus Lens
- ☐ **FSFL-F3R** Frosted Soft Focus Lens
- ☐ **WDL-F3R** Wide Distribution Lens*
  *(For use with 60° optic only)
- ☐ **FLSL-F3R** Frosted Linear Spread Lens

SQUARE ALTERNATE EFFECTS DEVICES
Dry / Damp location only
Wet location requires alternate baffle.

- ☐ **HCL-F3S** Honeycomb Louver w/ Diffusion Lens*
  *(Not available for Warm Dim, Wet locations, or Airtight Housings)
- ☐ **CGL-F3S** Clear Glass Lens*
  *(Not available for Warm Dim)
- ☐ **FGL-F3S** Frosted Glass Lens
- ☐ **SFL-F3S** Soft Focus Lens
- ☐ **FSFL-F3S** Frosted Soft Focus Lens
- ☐ **WDL-F3S** Wide Distribution Lens*
  *(For use with 60° optic only)
- ☐ **FLSL-F3S** Frosted Linear Spread Lens

REPLACEMENT OPTICS
Interchangeable optics accessible through fixture aperture.

- ☐ **RO-50-15-2** 15° optic
- ☐ **RO-50-22-2** 22° optic
- ☐ **RO-50-40-2** 40° optic
- ☐ **RO-50-60-2** 60° optic

REPLACEMENT TUNABLE WHITE OPTICS
Interchangeable optics accessible through fixture aperture.

- ☐ **RO-50-22-3** 22° optic
- ☐ **RO-50-40-3** 40° optic
- ☐ **RO-50-60-3** 60° optic

ALTERNATE BAFFLE ASSEMBLY (INCLUDES EFFECTS DEVICE)

ASSEMBLY		SHAPE	RATING	TYPE		BAFFLE FINISH		EFFECTS DEVICE
RBA	-			F	-		-	
REPLACEMENT BAFFLE ASSEMBLY		F3R Round F3S Square	1 Dry / Damp 2 Wet* *(Requires suction cup to service or aim & focus)	F Fixed		WH White BK Black PR Primer AU Cashmere Gold AG Satin Silver BB Burnt Bronze CF Custom Finish * *(Consult Factory)		Leave blank for standard Soft Focus Lens CGL Clear Glass Lens * *(Not available for Warm Dim) FGL Frosted Glass Lens FSFL Frosted Soft Focus Lens WDL Wide Distribution Lens * *(For use with 60° optic only) FLSL Frosted Linear Spread Lens

REPLACEMENT SUCTION TOOL
One included with every six fixtures designated Wet location.

- ☐ **F4-TOOL-SUCTION** Allows for removal of Wet Location baffles

T-GRID ACCESSORY KIT
Supplied with ceiling thickness "T" and recommended for installations in T-Grid and furring channel up to 1.5" tall. Available for ceiling thicknesses from 0.50" - 2.125".

- ☐ **TG-FX3-KIT**

HANGER BAR EXTENDER KIT
Extends hanger bars from 24.0" to 46.0" maximum.

- ☐ **FRX-HBE-46** Extender, Hanger Bar

EMERGENCY LIGHTING - REMOTE MOUNT ONLY
During disruption of main power, emergency battery inverter provides temporary 120V or 277V to fixture.

- ☐ **EMB-S-20/25-120/277-LEDX** 20/25 watt max capacity, 120 or 277 VAC 60Hz, Non-Dimmable
- ☐ **EMB-S-100-120-LEDX** 100 watt max capacity, 120 VAC 60Hz, Dimmable
- ☐ **EMB-S-100-277-LEDX** 100 watt max capacity, 277 VAC 60Hz, Dimmable
- ☐ **EMB-S-250-120/277-LEDX** 250 watt max capacity, 120 or 277 VAC 60Hz, Dimmable

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FRAXION3 SLIM FIXED

PERFORMANCE - 3000K

LUMEN PACKAGE	WATTAGE	10° OPTIC NO SOFT FOCUS LENS		15° OPTIC SOFT FOCUS LENS		22° OPTIC SOFT FOCUS LENS		40° OPTIC SOFT FOCUS LENS		60° OPTIC SOFT FOCUS LENS		85° OPTIC WIDE DISTRIBUTION LENS	
		DELIVERED	LPW	DELIVERED	LPW	DELIVERED	LPW	DELIVERED	LPW	DELIVERED	LPW	DELIVERED	LPW
80C12A	10	739	51 (14W)	872	86	729	72	795	79	784	78	623	62
80C16A	14	-	-	1191	82	1003	71	1095	78	1079	77	857	61
80C23A	21	-	-	1642	77	1381	65	1506	71	1486	70	1180	56
90C10A	10	627	44 (14W)	721	71	626	62	683	68	673	67	535	53
90C14A	14	-	-	984	68	858	61	936	66	923	65	733	52
90C19A	21	-	-	1357	63	1184	56	1291	61	1273	60	1011	48
97C10A	10	578	40 (14W)	657	65	557	55	608	60	599	59	476	47
97C12A	14	-	-	897	62	763	54	833	59	821	58	652	46
97C17A	21	-	-	1238	58	1055	50	1151	58	1135	54	901	42
90W11A	14	-	-	793	57	690	49	857	61	814	58	719	51
90W13A	14	-	-	835	60	726	51	902	64	857	61	757	54
90T12A	16	-	-	-	-	852	53	950	59	949	59	838	52

JA8-2019 INDICATED BY SHADING

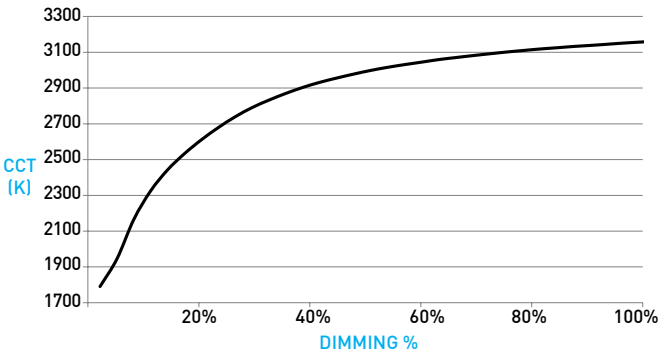
OUTPUT MULTIPLIER	
CCT	CCT SCALE
2200K (Consult factory for JA8 details)	0.800
2700K	0.957
3000K	1.000
3500K	1.019
4000K	1.030

LIGHT LOSS FACTOR MULTIPLIER	
CGL	1.05
SFL	1.00
FGL	0.90
FSFL	0.87
FLSL	0.83
WDL	0.78

WARM DIM PERFORMANCE - SOFT FOCUS LENS - 40° OPTIC

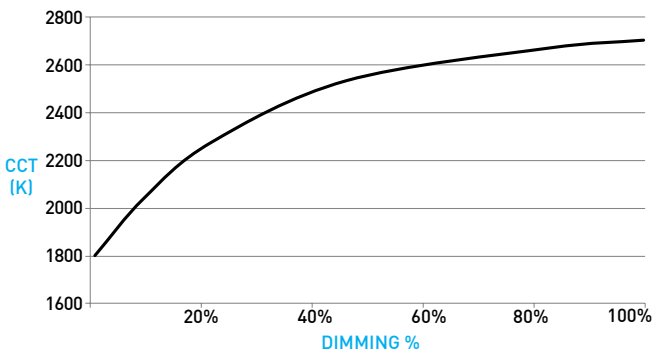
WARM DIM TO MIRROR HALOGEN DIMMING PROFILE

90W13A 3200K - 1800K	Full on 100%	Dimmed to 80%	Dimmed to 70%	Dimmed to 50%	Dimmed to 20%	Dimmed to 10%	Dimmed to 2%
CCT (K)	3200	3150	3100	3000	2700	2200	1800
Light Output (Lm)	902	722	631	451	180	90	18
Power (W)	14	11	10	7	3	1.5	0.3
Efficacy (LPW)	64	64	64	64	64	64	64



WARM DIM TO MIRROR INCANDESCENT DIMMING PROFILE

90W11A 2700K - 1800K	Full on 100%	Dimmed to 80%	Dimmed to 70%	Dimmed to 50%	Dimmed to 20%	Dimmed to 10%	Dimmed to 2%
CCT (K)	2700	2650	2620	2520	2180	1950	1800
Light Output (Lm)	857	686	600	428	171	86	17
Power (W)	14	11	10	7	3	1.5	0.5
Efficacy (LPW)	61	61	61	61	61	61	61



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FRAXION3 SLIM FIXED

DOWNLIGHT / HOUSING

A LED
Integral LED module design enables field service / replacement through housing aperture.

B OPTIC
Proprietary optic integrates Reflection, Refraction and TIR offering 10°, 15°, 22°, 40° & 60° beams.

C TRIMLESS WOOD SPACERS
Provided for Trimless Wood installations; includes (1) 1/16" spacer and (5) 1/8" spacers.

D TRIM EXTENSION
Provided for -2 ceiling thickness; accommodates 2.125" max ceiling thickness.

E MICROFLANGE PROFILE
Features 0.30" flange. Thickness measures 0.06". Installed after ceiling is complete. Requires 3.375" diameter cutout. Wet location features integral silicone gasket.

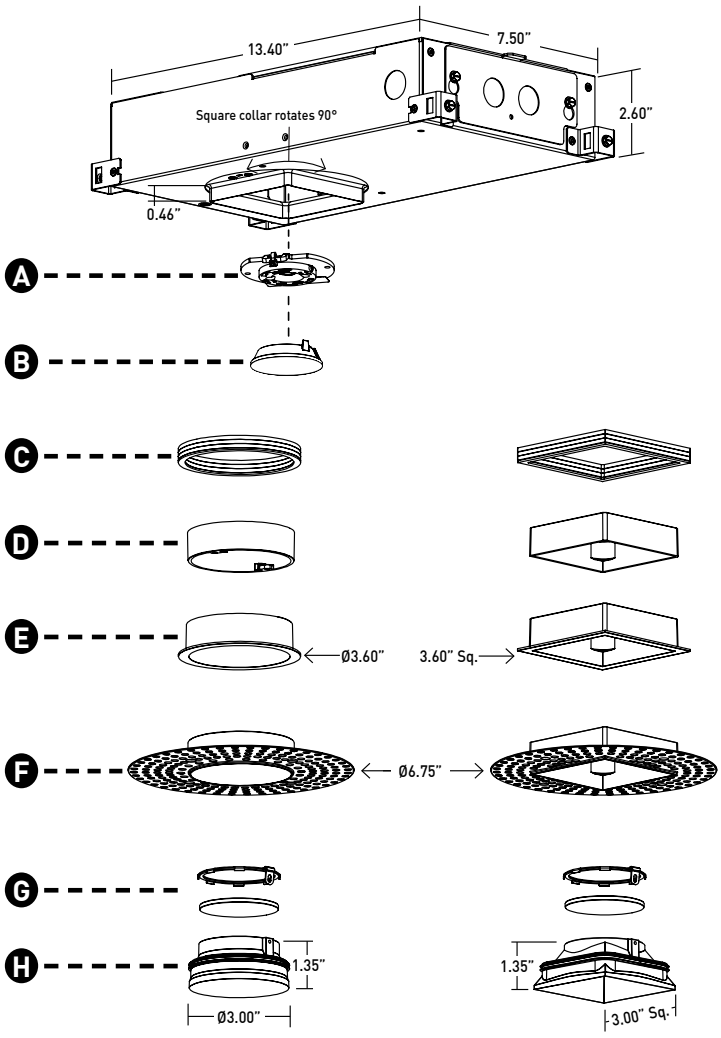
F TRIMLESS DRYWALL PROFILE
Installs totally flush with the ceiling with no visible trim. Appliqué includes screws for mounting and has 0.06" plaster stop. Not recommended for stucco applications.

G EFFECTS DEVICES / LENS RETAINER
Fixture is limited to 1 effects device. Wet location effects device is sealed in place. Suction tool provided for removal of baffle with wet location. Lens retainer allows effects devices to be changed in Dry /Damp locations.

H ROUND BAFFLE
Die-cast removable baffle provides easy access to tilting mechanism and features 62° glare cutoff. Minimizes aperture glare and conceals view into housing; includes gasket.

SQUARE TRANSITIONAL BAFFLE
Die-cast removable baffle provides easy access to tilting mechanism and features 62° glare cutoff. Transitions from square aperture at ceiling plane to round aperture at light source. Minimizes aperture glare and conceals view into housing; includes gasket.

DIMENSIONS / DRAWINGS



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FRAXION3 SLIM FIXED

DOWNLIGHT / HOUSING

I **IC HOUSING**
- For IC ceilings.
- No setback from polycell spray foam insulation having max R-Value of 60 on all sides and top of housing.

J **NIC HOUSING**
- Minimum 0.50" setback from combustible and non-combustible materials on all sides and top of housing.
- Minimum 3.00" setback from insulation material having max R-Value 30 on all sides and top of housing.
- Minimum 6.00" setback from polycell spray foam insulation having max R-Value 60.

K **ADJUSTABLE HANGER BAR HEIGHT ACCESSORY**
Provided with ceiling thickness "T" and recommended for installations in T-Grid and furring channel up to 1.5" tall. Hanger bars are installed to adjustable bracket. Allows housing to be raised and lowered; ceiling thickness remains 0.5" to 1.375" max.

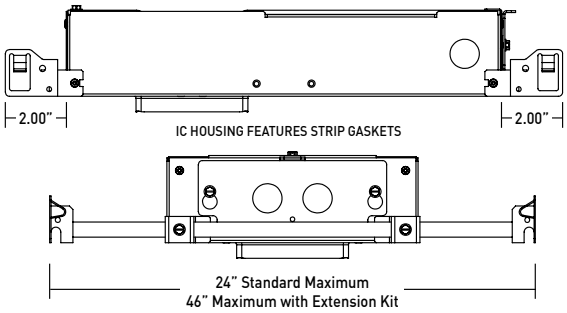
L **APPLIQUÉ DETAIL**
Appliqué for plaster floating directly to baffle.

M **REMOTE POWER SUPPLY**
Provided with install Types "V", "W" and "D". Remote power supply provides additional driver options. Consult installation guide for maximum allowable secondary run lengths between PSF3-RMT and fixture. Must be installed in an accessible location.

HOUSING NOTES

- Do not install in environments where ambient temperatures exceed 25°C (77°F).
- Power supply compartment and all splice connections may be serviced from room side.
- Consult factory for spacing requirements for any installations exceeding R-Value 60.
- Hanger bars fitted to short side of housing or long side when TG accessory is specified; extend from 14.0" to 24.0", but may be field cut to accommodate narrow stud spacing. Can be extended up to 46" maximum with FRX-HBE-46 kit.
- Hanger bars and brackets add 4.00" max to the overall dimension, but are exclusive of the setback requirements.
- Housings for round trims feature a round aperture housing collar. Housings for square trims feature a square housing collar that rotates up to 90 degrees for fixture alignment. Housing collars accommodate ceiling thicknesses between 0.50" and 2.125".

I / J



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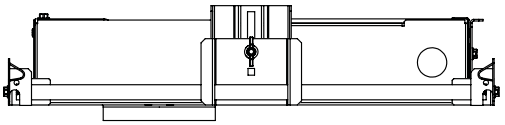

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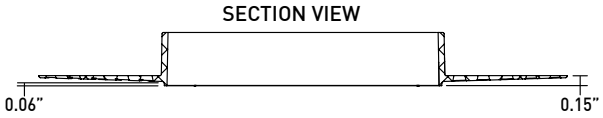

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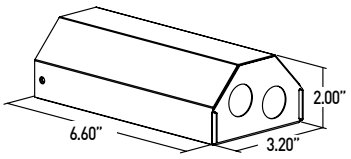

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FRAXION3 SLIM FIXED

TECHNICAL

CONSTRUCTION
Downlight: Painted finishes are granulated powder coat.
Housing: Aluminum and 22 Gauge galvanized steel. Extruded aluminum housing panel to act as heat-sink.
Remote Power Supply: 22 Gauge galvanized steel.
Appliqué: Zinc alloy.

STATIC WHITE LED
2-step MacAdam ellipse LED module available in 80+, 90+ and 97+ CRI configurations in color temperatures of 2200K, 2700K, 3000K, 3500K and 4000K. Average rated lamp life of 50,000 hours. LED and driver assemblies are field-replaceable.

WARM DIM LED
3-step MacAdam ellipse warm dim LED module available in 90+ CRI configuration. 3200K or 2700K at full brightness, warming to 1800K at full dim. Average rated lamp life of 50,000 hours. LED and driver assemblies are field-replaceable.

TUNABLE WHITE LED
5-step MacAdam ellipse tunable white LED module available in 90+ CRI configuration. Features tuning range of 2700K to 5000K. Average rated lamp life of 50,000 hours. LED and driver assemblies are field-replaceable.

POWER SUPPLY PERFORMANCE AND DIMMING INFORMATION

Power Supply	PH	SG	SN	LP	L2	EG	EN	ED	DG	DN	DD
Minimum °C	-20 °C	-10 °C	-10 °C	0 °C	0 °C	-20 °C	-20 °C	-20 °C	-20 °C	-20 °C	-20 °C
Maximum °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C
Dimming %	2.0%	1.0%	1.0%	0.1%	1.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

Note: For L2, LP, EG and EN drivers consult chart on page 7 to confirm appropriate dimming curve for compatibility with selected control.

LISTING
cTUVus listed to UL1598 standard for Dry / Damp and Wet locations. Chicago Plenum, Airtight and Title 24 JA8-2019 Listed.

WARRANTY
Manufacturer's 1-year warranty guarantees product(s) listed to be free from defects in material and workmanship under normal use and service. 5-year warranty on LED and power supply to operate with 70% of the original flux and remain within a range of 3 duv. 10-year Lutron Advantage limited warranty available on Lutron equipped systems. Warranty period begins from the date of shipment by Seller and conditional upon the use of manufacturer-supplied power supply. Consult website for full warranty terms and conditions.

CHANGE LOG
1. 01/12/2021: ADDED 2200K, 2700K-1800K WARM DIM AND 10 DEGREE OPTIC OFFERINGS.
2. 04/30/2021: REMOVED QUICK SHIP.

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FRAXION3 SLIM FIXED

DIMMING COMPATIBILITY

LUTRON DRIVER COMPATIBILITY

Power supply **L2** **Lutron Product Family**	**Part No.**
Maestro WirelessR 600 W dimmer	MRF2-6ND-120-
Maestro WirelessR 1000 W dimmer	MRF2-10ND-120-
Caséta® Wireless Pro 1000 W dimmer	PD-10NXD-
GRAFIK T™ CL® dimmer	GT-250M- GTJ-250M-
HomeWorks® QS adaptive dimmer	HQRD-6NA-
HomeWorks® QS 600 W dimmer	HQRD-6ND-
HomeWorks® QS 1000 W dimmer	HQRD-10ND-
RadioRA® 2 adaptive dimmer	RRD-6NA-
RadioRA® 2 1000 W dimmer	RRD-10ND
myRoom™ DIN power module	MQSE-4A1-D
HomeWorks® QS DIN power module	LQSE-4A1-D
HomeWorks® QS wallbox power module	HQRJ-WPM-6D-120
HomeWorks® wallbox power module	HWI-WPM-6D-120
GRAFIK Eye® QS control unit	QSGR-, QSGRJ-
GRAFIK Eye® 3000 control unit	GRX-3100- GRX-3500-
RPM-4U module (LCP, HomeWorks® QS, GRAFIK Systems™, Quantum®)	HW-RPM-4U-120 LP-RPM-4U-120
RPM-4A module (LCP, HomeWorks® QS, GRAFIK Systems™, Quantum®)	HW-RPM-4A-120, LP-RPM-4A-120
GP dimming panels	Various
Ariadni CL 250W dimmer	AYCL-253P-
Diva CL 250W dimmer	DVCL-253P- DCSCCL-253P-
Nova T CL 250W dimmer	NTCL-250-
Power supply **LP** **Lutron Product Family**	**Part No.**
PowPak Dimming Modules	RMJ-ECO32-DV-B
PowPak Dimming Modules	FCJ/FCJS-ECO
Energi Savr Nodes	QSN-1ECO-S
GRAFIK Eye QS control unit Homeworks QS control unit	QSN-2ECO-S
GRAFIK Eye QS control unit Homeworks QS control unit	QSGRJ-_E (wireless) QSGR-_E
Quantum Hub	QP2-_ _ 2C
Quantum Hub	QP2-_ _ 4C
Quantum Hub	QP2-_ _ 6C
Quantum Hub	QP2-_ _ 8C
Homeworks QS power module myRoom Plus power module	LQSE-2ECO-D

LUTRON
2016 OEM ADVANTAGE ACCOUNT

eldoLED DRIVER COMPATIBILITY

Power supply **EG / EN** **Dimmer / Switch Control Manufacturer**	**Family/Model #**
Busch-Jaeger	2112U-101
Jung	240-10
Leviton Lighting Controls	IP710-DLX
Lightolier Controls	ZP600FAM120
Lutron Electronics	Nova T® - NTFTV
Lutron Electronics	Diva® - DVTV
Lutron Electronics	Nova® - NFTV
Merten	5729
Pass & Seymour	CD4FB-W
The Watt Stopper	DCLV1
Sensor Switch	nIO EZ
Synergy	ISD BC
Power supply **EG / EN** **Lighting Control System Manufacturer**	**Family/Model #**
Lutron Electronics	GrafixEye® GRX-TVI w GRX3503
Lutron Electronics	Energy Savr Node™ - QSN-4T16-S
Lutron Electronics	TVM2 Module
Crestron®	GLX-DIMFLV8
Crestron®	GLXP-DIMFLV8
Crestron®	GLPAC-DIMFLV4-*
Crestron®	GLPAC-DIMFLV8-*
Crestron®	GLPP-DIMFLVEX-PM
Crestron®	GLPP-1DIMFLV2EX-PM
Crestron®	GLPP-1DIMFLV3EX-PM
Crestron®	DIN-AO8
Crestron®	DIN-4DIMFLV4
Crestron®	CLS-EXP-DIMFLV
Crestron®	CLCI-1DIMFLV2EX
ABB	SD/S 2.16.1

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NOT USED

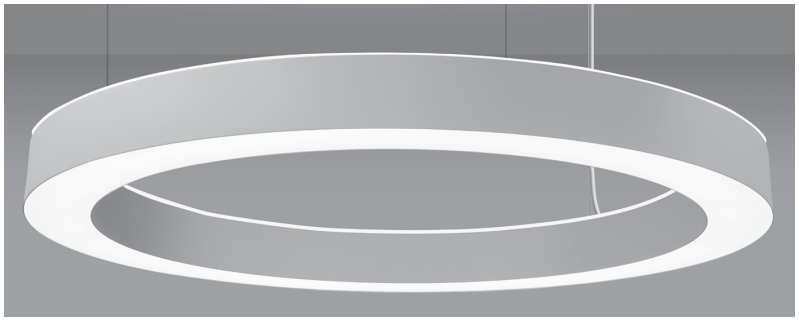
Preliminary 01/25/21

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

High Performance 4" Aperture Circle (HP-4 C)



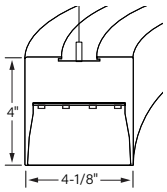
High Performance 4" Aperture Circle (HP-4 C) is a patented, circular LED luminaire. Constructed with an extruded aluminum body and single-piece direct diffuser, the HP-4 C provides a seamless finish aesthetic. Delivering excellent performance using an advanced optical design and mid-power LEDs to achieve 90% of initial light output at 100,000+ hours.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options acheiving Red List Approved and Declared status.

Signal White is standard finish

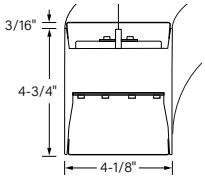
CROSS SECTION

Direct Pendant

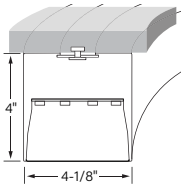


Flush Downlight Diffuser (standard)

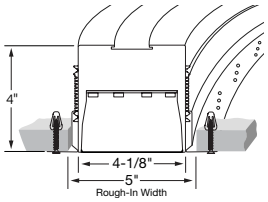
Indirect/Direct
Top Glow Diffuser (standard)



Surface Mount



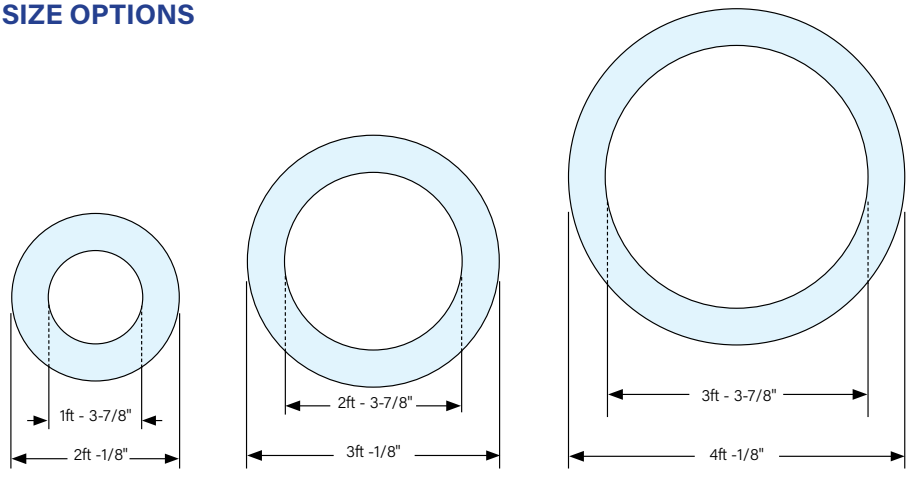
Recessed
(Spackle Flange Only)



GET MORE WITH TAILORED LIGHTING

- Tailored Color
- Tailored Output
- Tailored Control

SIZE OPTIONS



Protected by one or more US Patents: 8915613; D702,391; D702,390; D700,732

Preliminary 01/25/21

BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

High Performance 4" Aperture Circle (HP-4 C)

Clear Form

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Size (Diameter) [1]
◉ HP - High Performance	◉ 4 C	○ P - Pendant ○ R - Recessed *(Spackle Flange Only)* ○ SM - Surface Mount	○ D - Direct ○ ID - Indirect/Direct *(Pendant Only)*	○ 2' ○ 3' ○ 4'

OUTPUT and LED TYPE

Uplight Output ID only	Downlight Output	LED CRI/CCT
○ S - Standard ○ B - Boosted Standard ○ H - High ○ V - Very High ○ TL - Tailored: _____lm/ft*	○ S - Standard ○ B - Boosted Standard ○ H - High ○ V - Very High ○ TL - Tailored: _____lm/ft*	○ 830 - 80 CRI, 3000K ○ 835 - 80 CRI, 3500K ○ 840 - 80 CRI, 4000K ○ 930 - 90 CRI, 3000K ○ 935 - 90 CRI, 3500K ○ 940 - 90 CRI, 4000K ○ 8TW - 80 CRI, Tunable White ○ 9TW - 90 CRI, Tunable White

* Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

MECHANICAL/OPTICAL OPTIONS

Uplight ID only	Downlight	Reflector System
○ TG - Top Glow (standard) ○ F - Flush	◉ F - Flush	◉ 96 - 96 Low Gloss

ELECTRICAL OPTIONS

Voltage	Circuiting [2]	Driver Selection
○ 120 - 120 Voltage ○ 277 - 277 Voltage ○ 347 - 347 Voltage	○ SC - Single Circuit* One single circuit in a run ○ DC - Dual Circuit* [3] Independent control of up and down separately in an I/D style fixture * Emergency to Generator circuits are in addition to the normal luminaire circuit(s)	**0-10V Driver Options** ○ FC-10% - 0-10V 10% (standard) [4] ○ FC-1% - 0-10V 1% [4] ○ OSR-10% - Osram OTi, 0-10V 10% [4] ○ OSR-1% - Osram OTi, 0-10V 1% [4] ○ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1% [5] ○ ELD-10V-1% - EldoLED SOLOdrive, 0-10V 1% [5] ○ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [4] **DALI Driver Options** [5] ○ FC-DALI-1% - DALI 1% ○ OSR-DALI-1% - Osram Dexal, 1% ○ ELD-DALI-0% - EldoLED SOLOdrive, DALI 0.1% ○ ELD-DALI-TW - EldoLED DUALdrive LightShape, 1% *(Tunable White)* **DMX Driver Options** ○ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTUNE Controls Only)* [6] **Lutron Driver Options** [5] ○ LUT-ES1 - Lutron, Ecosystem 1% ○ LUT-ES5 - Lutron, Ecosystem 5% ○ LUT-2W - Lutron, 2-wire (120v only) 1% ○ LUT-TW - Lutron T-Series, EcoSystem 1% *(Tunable White)* See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method	Ceiling Hardware Type [7]
○ FA50 - Fully Adjustable 50" (Standard) [8] ○ FA100 - Fully Adjustable 100" [8] ○ FA150 - Fully Adjustable 150" [8] ○ FA200 - Fully Adjustable 200" [8] ○ FA250 - Fully Adjustable 250" [8] ○ FA300 - Fully Adjustable 300" [8] ○ SF - Spackle Flange [9]	○ C1 - 1" T-Bar [7] ○ C2 - 9/16" T-Bar [7] ○ C3 - Screw Slot [7] ○ C4 - Hard Ceiling [7]

OTHER OPTIONS

Finish	Emergency Style (Optional)	Special Options (Optional)
○ SW - Signal White ○ FB - Finelite Black [10] ○ SA - Satin Aluminum [10] ○ #### - RAL Color Code [10]	○ EM/GEN - Emergency to Generator ○ ALCR - Automatic Load Control Relay	○ CP - Chicago Plenum [11] ○ FLX - Flex Whip [11] ○ RLA - Red List Approved ○ RLD - Declared

[1] Nominal size
[2] Contact factory for switching options
[3] Indirect/Direct only
[4] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[5] 3' & 4' diameters only
[6] B & V outputs only
[7] Pendant and Surface Mount only
[8] Pendant only
[9] Recessed only
[10] 20 business days lead time for color
[11] Recessed and Pendant (Only available with C1, C2, and C3 mounting hardware with Finelite Gridbox)

Protected by one or more US Patents: 8915613; D702,391; D702,390; D700,732

Preliminary 01/25/21

Submitted by:	Date:
Type:	Project:
Ordering Info:	

BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

High Performance 4" Aperture Circle (HP-4 C)

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory choice 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory choice 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory choice 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory choice 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%[1]	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%[1]	EldoLED SOLOdrive, 0-10V 1% Dimming (Linear)
OSR-10vTW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10vTW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options[1]	
FC-DALI-1%	Factory choice DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED SOLOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED Dual Drive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX[2]	Finelite DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)

Lutron Driver Options[1]	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-ES5	Lutron, Ecosystem 5% Dimming
LUT-2W	Lutron, 2-wire (120v only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

[1] 3' & 4' diameters only
[2] B & V outputs only

Preliminary 01/25/21

Submitted by:	Date:
Type:	Project:
Ordering Info:	

BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

High Performance 4" Aperture Circle (HP-4 C)

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6063-T4 extruded aluminum with 16 gauge steel assembly body.

SIZES: Circles are available in nominal diameters of 2', 3' and 4'.

OUTPUT and LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. A separate chart summarizes lumen distribution and wattage. Light engines are replaceable.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

MECHANICAL FEATURES

UPLIGHT DIFFUSER: Patented Top Glow frost white diffuser standard. 80% transmissive, 99% diffusion. Optional: Flush frost white snap-in diffuser, 80% transmissive, 99% diffusion.

DOWNLIGHT DIFFUSER: Single piece, seamless lens. Flush frost white snap-in lens standard, 80% transmissive, 99% diffusion.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint.

ELECTRICAL FEATURES

STATIC FEED: Standard with one 18-gauge/5-conductor single-circuit feed.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 100%-10% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.

- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS [1]:

- **LUTES1** (Hi-lume 1% EcoSystem with Soft-On, Fade to Black dimming (LDE1 series))
- **LUTES5** (5-Series 5% EcoSystem (LDE5 Series))
- **LUT2W** (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series))

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.

- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime.:** 100,000 hours
- FineTune DMX is 1%

LUTRON TUNABLE WHITE DRIVER OPTION [1]: LUTDTW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING TYPE

MOUNTING:

- **Pendant:** 50" to 300" Fully Adjustable (**FA**) plated steel aircraft cable with safety stop hardware standard. Mounted with three equidistant vertical suspension cables.
- **Recessed Spackle Flange**: Drywall surfaces (walls or ceilings): 1/4" 20 stud and nut (provided by others). Mounted with three equidistant suspension points.
- **Surface Mount**: Lay-in ceiling types: caddy clip with 1/4" 20 stud and nut. Drywall or concrete surfaces (walls or ceilings): 1/4" 20 stud and nut (provided by others). Mounted with three equidistant suspension points.

TUNABLE WHITE DMX MOUNTING: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5', 12', and 30' (5' standard).

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are prewired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER FEATURES

EMERGENCY STYLE: Optional emergency to generator/inverter wiring.

[1] 3' & 4' only

Preliminary 01/25/21

Submitted by:	Date:
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BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

High Performance 4" Aperture Circle (HP-4 C)

SPECIFICATIONS

TUNABLE WHITE ELECTRICAL OPTIONS:
- **TW Driver Options 0-10V:** EM/GEN
- **FineTune DMX:** EM/GEN
- **DALI:** EM/GEN
- **LUTRON:** EM/GEN

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**)[2], and Satin Aluminum (**SA**)[2] are standard. Optional Adder: 185 RAL colors[2] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 PoE options available on request. These fixtures are rated for Damp Location. Chicago Plenum options available for C1, C2, or C3 suspension using our GridBox. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add - **RLA** (Red List Approved) or - **RLD** (Declared Label) to your part number.

WEIGHTS:
- Direct (pendant and surface mount): 2' = 15 lbs, 3' = 27 lbs, 4' = 42 lbs
- Recessed (spackle flange): 2' = 18 lbs, 3' = 30 lbs, 4' = 45 lbs
- Indirect/Direct (pendant): 2' = 18 lbs, 3' = 30 lbs, 4' = 45 lbs

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories are covered by their individual manufacturer warranties.

[2] 20 business day lead time for color

Preliminary 01/25/21

BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

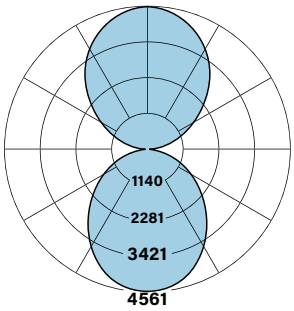
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

High Performance 4" Aperture Circle (HP-4 C)

INDIRECT/DIRECT PHOTOMETRY
4' CIRCLE 3500K

HP-4C-P-ID-4'-V-V-835
Uplight: Flush / **Downlight:** Flush

Distribution: 51% Up (**V**) / 49% Down (**V**)
Efficacy: 107 lm/W
Uplight: 11798 lumens
Downlight: 11229 lumens
Total luminaire output: 23027 lumens
215.0 watts (17.1 watts/foot [3])
Peak Candela Value [4]: 4561 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 93249



CANDELA DISTRIBUTION [4]

	0	45	90	135	180	FLUX
0	4561	4561	4561	4561	4561	
5	4538	4538	4534	4526	4522	430
15	4293	4293	4305	4269	4234	1206
25	3812	3827	3855	3792	3721	1754
35	3180	3220	3255	3176	3101	2002
45	2506	2549	2600	2513	2442	1958
55	1835	1878	1922	1854	1795	1673
65	1219	1243	1282	1231	1192	1231
75	679	675	687	675	663	720
85	256	233	201	233	249	265
90	122	87	47	79	114	
95	268	237	205	229	260	275
105	769	738	702	710	738	774
115	1373	1353	1334	1326	1330	1329
125	2036	2044	2008	1989	1961	1797
135	2726	2734	2711	2648	2632	2078
145	3389	3393	3385	3318	3291	2099
155	3950	3942	3946	3890	3871	1805
165	4328	4332	4336	4313	4301	1219
175	4538	4534	4534	4534	4538	430
180	4561	4561	4561	4561	4561	

4'

Total Light Output, 3500K, 80 CRI (Lumens)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	9426 [↑51% | 49%↓]	10668 [↑57% | 43%↓]	13773 [↑67% | 33%↓]	16395 [↑72% | 28%↓]
↓B [1]	10608 [↑46% | 54%↓]	11850 [↑51% | 49%↓]	14955 [↑61% | 39%↓]	17577 [↑67% | 33%↓]
↓H [1]	13563 [↑36% | 64%↓]	14805 [↑41% | 59%↓]	17910 [↑51% | 49%↓]	20532 [↑57% | 43%↓]
↓V [1]	16059 [↑30% | 70%↓]	17300 [↑35% | 65%↓]	20405 [↑45% | 55%↓]	23027 [↑51% | 49%↓]

Power, 3500K (Watts Per Foot) [3]

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	6.7	7.5	9.7	11.6
↓B [1]	7.6	8.5	10.7	12.5
↓H [1]	10.1	10.9	13.1	15.0
↓V [2]	12.2	13.0	15.2	17.1

Efficacy, 3500K, 80CRI (Lumens Per Watt)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	112	112	113	113
↓B [1]	110	111	111	111
↓H [1]	107	108	109	109
↓V [2]	105	105	107	107

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), Standard (**S**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789
Total Light Output: 13773 lm x 0.789 = 10867 lm
Total Light Output per Foot [3]: 10867 lm/ft / 12.6 = 862 lm/ft.
watts/foot: 9.7 W/ft.

$$\textbf{Efficacy} = \frac{862\ \frac{\text{lm}}{\text{ft.}}}{9.7\ \frac{\text{W}}{\text{ft.}}} = 89\ \text{lm/W}$$

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

[1] Family Correlation based on 4' Circle, 3500K, Very High Output (V) test - 120V.
[2] Based on ITL report: 93249
[3] Lumens per foot and Watts per foot calculated using approximate outer circumferences of 6.3', 9.4', & 12.6' respectively for 2', 3', & 4' circles
[4] Values derived from testing a 90-degree section.

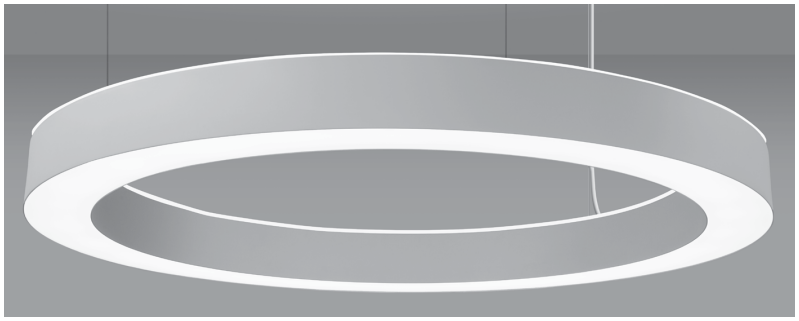
Preliminary 01/25/21

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

High Performance 4" Aperture Circle (HP-4 C)



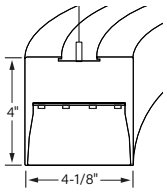
High Performance 4" Aperture Circle (HP-4 C) is a patented, circular LED luminaire. Constructed with an extruded aluminum body and single-piece direct diffuser, the HP-4 C provides a seamless finish aesthetic. Delivering excellent performance using an advanced optical design and mid-power LEDs to achieve 90% of initial light output at 100,000+ hours.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options acheiving Red List Approved and Declared status.

Signal White is standard finish

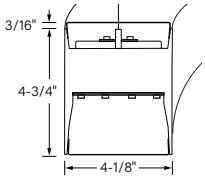
CROSS SECTION

Direct Pendant

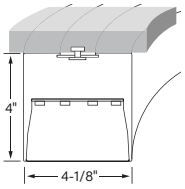


Flush Downlight Diffuser (standard)

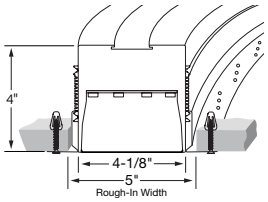
Indirect/Direct
Top Glow Diffuser (standard)



Surface Mount



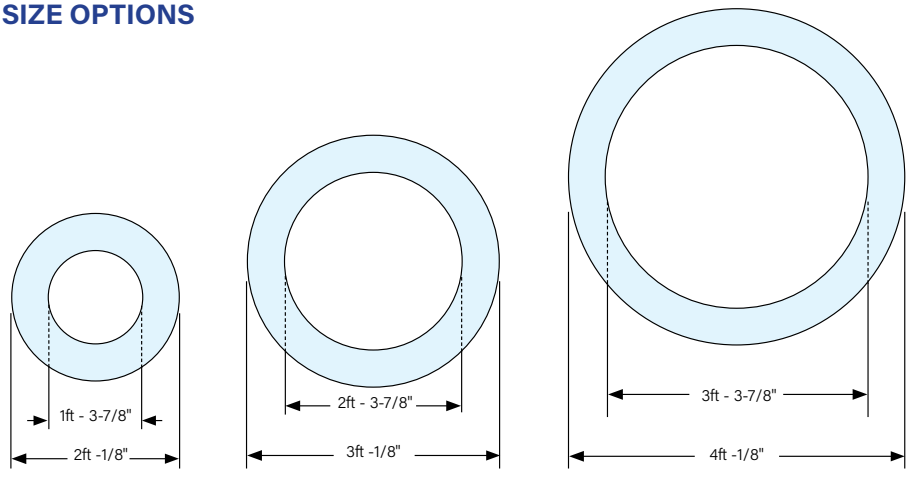
Recessed
(Spackle Flange Only)



GET MORE WITH TAILORED LIGHTING

- Tailored Color
- Tailored Output
- Tailored Control

SIZE OPTIONS



Protected by one or more US Patents: 8915613; D702,391; D702,390; D700,732

Preliminary 01/25/21

BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

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High Performance 4" Aperture Circle (HP-4 C)

Clear Form

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Size (Diameter) [1]
◉ HP - High Performance	◉ 4 C	○ P - Pendant ○ R - Recessed *(Spackle Flange Only)* ○ SM - Surface Mount	○ D - Direct ○ ID - Indirect/Direct *(Pendant Only)*	○ 2' ○ 3' ○ 4'

OUTPUT and LED TYPE

Uplight Output ID only	Downlight Output	LED CRI/CCT
○ S - Standard ○ B - Boosted Standard ○ H - High ○ V - Very High ○ TL - Tailored: _____lm/ft*	○ S - Standard ○ B - Boosted Standard ○ H - High ○ V - Very High ○ TL - Tailored: _____lm/ft*	○ 830 - 80 CRI, 3000K ○ 835 - 80 CRI, 3500K ○ 840 - 80 CRI, 4000K ○ 930 - 90 CRI, 3000K ○ 935 - 90 CRI, 3500K ○ 940 - 90 CRI, 4000K ○ 8TW - 80 CRI, Tunable White ○ 9TW - 90 CRI, Tunable White

* Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

MECHANICAL/OPTICAL OPTIONS

Uplight ID only	Downlight	Reflector System
○ TG - Top Glow (standard) ○ F - Flush	◉ F - Flush	◉ 96 - 96 Low Gloss

ELECTRICAL OPTIONS

Voltage	Circuiting [2]	Driver Selection
○ 120 - 120 Voltage ○ 277 - 277 Voltage ○ 347 - 347 Voltage	○ SC - Single Circuit* One single circuit in a run ○ DC - Dual Circuit* [3] Independent control of up and down separately in an I/D style fixture * Emergency to Generator circuits are in addition to the normal luminaire circuit(s)	**0-10V Driver Options** ○ FC-10% - 0-10V 10% (standard) [4] ○ FC-1% - 0-10V 1% [4] ○ OSR-10% - Osram OTi, 0-10V 10% [4] ○ OSR-1% - Osram OTi, 0-10V 1% [4] ○ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1% [5] ○ ELD-10V-1% - EldoLED SOLOdrive, 0-10V 1% [5] ○ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [4] **DALI Driver Options** [5] ○ FC-DALI-1% - DALI 1% ○ OSR-DALI-1% - Osram Dexal, 1% ○ ELD-DALI-0% - EldoLED SOLOdrive, DALI 0.1% ○ ELD-DALI-TW - EldoLED DUALdrive LightShape, 1% *(Tunable White)* **DMX Driver Options** ○ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTUNE Controls Only)* [6] **Lutron Driver Options** [5] ○ LUT-ES1 - Lutron, Ecosystem 1% ○ LUT-ES5 - Lutron, Ecosystem 5% ○ LUT-2W - Lutron, 2-wire (120v only) 1% ○ LUT-TW - Lutron T-Series, EcoSystem 1% *(Tunable White)* See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method	Ceiling Hardware Type [7]
○ FA50 - Fully Adjustable 50" (Standard) [8] ○ FA100 - Fully Adjustable 100" [8] ○ FA150 - Fully Adjustable 150" [8] ○ FA200 - Fully Adjustable 200" [8] ○ FA250 - Fully Adjustable 250" [8] ○ FA300 - Fully Adjustable 300" [8] ○ SF - Spackle Flange [9]	○ C1 - 1" T-Bar [7] ○ C2 - 9/16" T-Bar [7] ○ C3 - Screw Slot [7] ○ C4 - Hard Ceiling [7]

OTHER OPTIONS

Finish	Emergency Style (Optional)	Special Options (Optional)
○ SW - Signal White ○ FB - Finelite Black [10] ○ SA - Satin Aluminum [10] ○ #### - RAL Color Code [10]	○ EM/GEN - Emergency to Generator ○ ALCR - Automatic Load Control Relay	○ CP - Chicago Plenum [11] ○ FLX - Flex Whip [11] ○ RLA - Red List Approved ○ RLD - Declared

[1] Nominal size
[2] Contact factory for switching options
[3] Indirect/Direct only
[4] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[5] 3' & 4' diameters only
[6] B & V outputs only
[7] Pendant and Surface Mount only
[8] Pendant only
[9] Recessed only
[10] 20 business days lead time for color
[11] Recessed and Pendant (Only available with C1, C2, and C3 mounting hardware with Finelite Gridbox)

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OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

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MECHANICAL FEATURES

UPLIGHT DIFFUSER: Patented Top Glow frost white diffuser standard. 80% transmissive, 99% diffusion. Optional: Flush frost white snap-in diffuser, 80% transmissive, 99% diffusion.

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STATIC FEED: Standard with one 18-gauge/5-conductor single-circuit feed.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 100%-10% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.

- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS [1]:

- **LUTES1** (Hi-lume 1% EcoSystem with Soft-On, Fade to Black dimming (LDE1 series))
- **LUTES5** (5-Series 5% EcoSystem (LDE5 Series))
- **LUT2W** (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series))

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.

- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime.:** 100,000 hours
- FineTune DMX is 1%

LUTRON TUNABLE WHITE DRIVER OPTION [1]: LUTDTW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING TYPE

MOUNTING:

- **Pendant:** 50" to 300" Fully Adjustable (**FA**) plated steel aircraft cable with safety stop hardware standard. Mounted with three equidistant vertical suspension cables.
- **Recessed Spackle Flange**: Drywall surfaces (walls or ceilings): 1/4" 20 stud and nut (provided by others). Mounted with three equidistant suspension points.
- **Surface Mount**: Lay-in ceiling types: caddy clip with 1/4" 20 stud and nut. Drywall or concrete surfaces (walls or ceilings): 1/4" 20 stud and nut (provided by others). Mounted with three equidistant suspension points.

TUNABLE WHITE DMX MOUNTING: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5', 12', and 30' (5' standard).

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are prewired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER FEATURES

EMERGENCY STYLE: Optional emergency to generator/inverter wiring.

[1] 3' & 4' only

Preliminary 01/25/21

BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

Submitted by:	Date:
Type:	Project:
Ordering Info:	

High Performance 4" Aperture Circle (HP-4 C)

SPECIFICATIONS

TUNABLE WHITE ELECTRICAL OPTIONS:
- **TW Driver Options 0-10V:** EM/GEN
- **FineTune DMX:** EM/GEN
- **DALI:** EM/GEN
- **LUTRON:** EM/GEN

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**)[2], and Satin Aluminum (**SA**)[2] are standard. Optional Adder: 185 RAL colors[2] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 PoE options available on request. These fixtures are rated for Damp Location. Chicago Plenum options available for C1, C2, or C3 suspension using our GridBox. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add - **RLA** (Red List Approved) or - **RLD** (Declared Label) to your part number.

WEIGHTS:
- Direct (pendant and surface mount): 2' = 15 lbs, 3' = 27 lbs, 4' = 42 lbs
- Recessed (spackle flange): 2' = 18 lbs, 3' = 30 lbs, 4' = 45 lbs
- Indirect/Direct (pendant): 2' = 18 lbs, 3' = 30 lbs, 4' = 45 lbs

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories are covered by their individual manufacturer warranties.

[2] 20 business day lead time for color

Preliminary 01/25/21

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

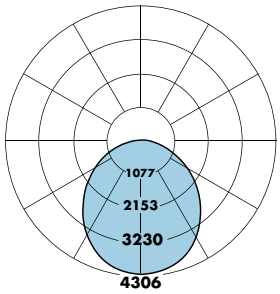
BUY AMERICAN ACT COMPLIANT

FINELITE® Better Lighting

High Performance 4" Aperture Circle (HP-4 C)

Static White Photometry - 4' Circle

HP-4C-P-D-4'-V-835
Efficacy: 100 lm/W
Total luminaire output: 11311 lumens
113 watts (9.0 watts/foot [3])
Peak Candela Value [4]: 4306 @ 0°
CRI: 80
CCT: 3500K
ITL LM79 Report 91221



CANDELA DISTRIBUTION [4]

	0	22.5	45.0	67.5	90.0	FLUX
0	4306	4306	4306	4306	4306	
5	4282	4282	4282	4282	4282	407
15	4056	4064	4080	4083	4103	1151
25	3654	3662	3685	3717	3741	1702
35	3124	3140	3168	3208	3220	1988
45	2539	2555	2579	2607	2631	1997
55	1922	1934	1958	1978	1998	1754
65	1301	1309	1325	1341	1349	1316
75	704	712	720	728	728	764
85	203	203	203	203	203	232
90	0	0	0	0	0	

Total Light Output, 3500K, 80 CRI (Lumens)				
	S [1]	B [1]	H [1]	V [2]
2'	2377	2988	4516	5806
3'	3934	4945	7474	9610
4'	4630	5821	8797	11311

Power, 3500K (Watts Per Foot) [3]				
	S [1]	B [1]	H [1]	V [2]
2'	3.6	4.6	7.1	9.2
3'	4.0	5.1	7.8	10.2
4'	3.5	4.5	6.9	9.0

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	S [1]	B [1]	H [1]	V [2]
2'	105	104	102	100
3'	105	104	102	100
4'	105	104	102	100

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 2', 4000K, 90 CRI

Lumen Adjustment Factor: 0.789
Total Light Output: 4516 lm x 0.789 = 3563 lm
Total Light Output per Foot [3]: 3563lm / 12.6 = 566 lm/ft.
watts/foot: 7.1 W/ft.

$$\textbf{Efficacy} = \frac{566\ \frac{\text{lm}}{\text{ft.}}}{7.1\ \frac{\text{W}}{\text{ft.}}} = 80\ \text{lm/W}$$

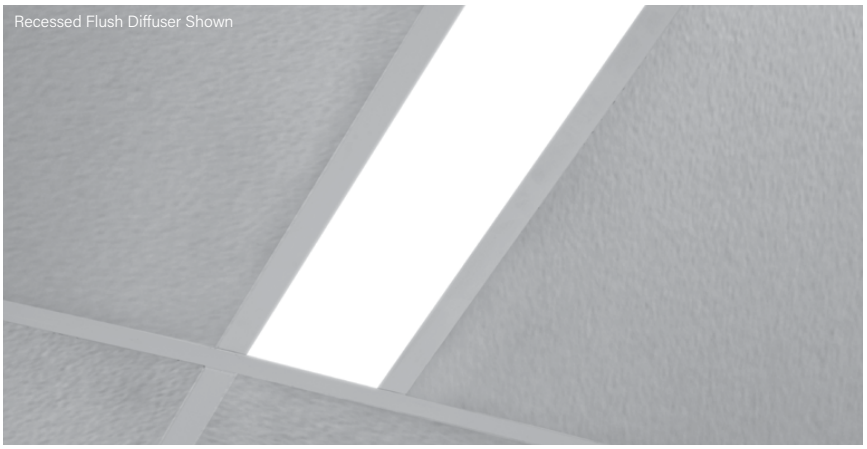
S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' Circle, 3500K, Very High Output (V) test - 120V.
[2] Based on ITL report: 91221
[3] Watts per foot calculated using approximate outer circumferences of 6.3', 9.4', & 12.6' respectively for 2', 3', & 4' circles
[4] Values derived from testing a 90-degree section.

NOT USED

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Recessed



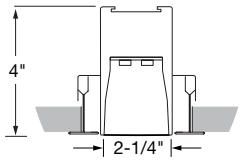
High Performance 2" Aperture is a patented, linear LED luminaire family. HP-2 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

Note: see page 6 for all aesthetic options

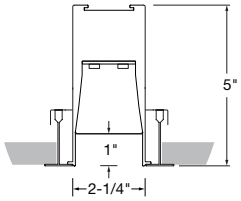
CROSS SECTIONS

Recessed



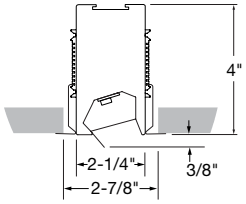
Flush Downlight Diffuser (standard)

Regressed



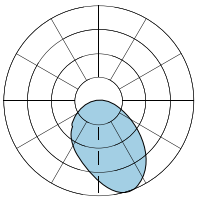
Flat Diffuser with 1" Regressed

Wall Wash Recessed

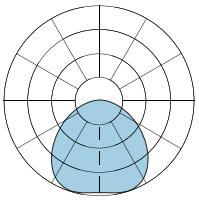


Kicker (standard)

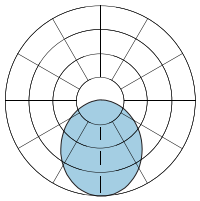
OPTIC OPTIONS



Downlight Asymmetric Optic (**DAO**)



Downlight Spread Optic (**DSO**)



Standard Downlight Flush Optic (**F**)

ALSO AVAILABLE IN

Pendant (**D, ID, I**)

Wall Mount (**WM**)

Surface Mount (**SM**)

Also available in Indigo-Clean. See Indigo-Clean Tech Sheet

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Recessed

Clear Form

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	◉ 2	◯ R - Recessed ◯ R RG - Recessed Regressed (Wall Wash not available)	◯ D - Direct ◯ WW-D - Wall Wash Direct	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT AND LED TYPE

Downlight Output (Flush)

◯ S - Standard (336 lm/ft)
◯ B - Boosted (423 lm/ft)
◯ H - High (639 lm/ft)
◯ V - Very High (822 lm/ft)
◯ TL - Tailored:_____lm/ft*

* Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

OUTPUT AND LED TYPE

LED CRI/CCT

◯ 830 - 80 CRI, 3000K
◯ 835 - 80 CRI, 3500K
◯ 840 - 80 CRI, 4000K
◯ 930 - 90 CRI, 3000K
◯ 935 - 90 CRI, 3500K
◯ 940 - 90 CRI, 4000K
◯ 8TW - 80 CRI, Tunable White
◯ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Downlight

◯ F - Flush (standard)
◯ DL - 1" Drop Down Lens
◯ RG-D - Flat Diffuser with 1" Regress [1]
◯ RG-WCB - White Cross Blade Baffle [1]
◯ RG-LHE - Hollowed Ellipse Louver [1]
◯ RG-LHC - Hex Louver [1]
◯ DAO-L - Downlight Asymmetric Left [4]
◯ DAO-R - Downlight Asymmetric Right [4]
◯ DSO - Downlight Spread Optic [4]
◯ K - Kicker for Wall Wash only (standard)
◯ FO - Fully Open for Wall Wash only

Reflector System

◯ 96LG - 96 Low Gloss White
◯ SW - Signal White for Wall Wash only

ELECTRICAL OPTIONS

Voltage

◯ 120 - 120 Voltage
◯ 277 - 277 Voltage
◯ 347 - 347 Voltage

Circuiting [2]

◯ SC - Single Circuit*
One single circuit in a run
◯ MC - Multi-Circuit*
More than one switch leg or zone. Factory shop drawings required

* Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS

Driver Selection

0-10V Driver Options

◯ FC-10% - 0-10V 10% [3] (standard)
◯ FC-1% - 0-10V 1% [3]
◯ OSR-10% - Osram OTi, 0-10V 10% [3]
◯ OSR-1% - Osram OTi, 0-10V 1% [3]
◯ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%
◯ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [3]

DALI Driver Options

◯ FC-DALI-1% - DALI 1%
◯ OSR-DALI-1% - Osram Dexal, 1%
◯ ELD-DALI-0% - EldoLED SOLOdrive, 0.1%
◯ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*

DMX Driver Options

◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [5]
◯ ELD-DMX - EldoLED POWERdrive, 0.1%
◯ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options

◯ LUT-ES1 - Lutron, Ecosystem 1%
◯ LUT-2W - Lutron, 2-wire (120V only) 1%
◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Ceiling Hardware Type

◯ C1 - 1" T-Bar
◯ C1T - 1" Tegular
◯ C2 - 9/16" T-Bar
◯ C2T - 9/16" Tegular
◯ C3 - Screw Slot
◯ C3F - Flush Screw Slot
◯ SF - Spackle Flange
◯ VF - Visible Flange
◯ TZ4 - Tech Zone 4" _____ (C1, C2, C2T, C3, C3F)

OTHER OPTIONS

Endcap Style

◉ FE - Flat Endcap (standard)

Finish

◯ SW - Signal White (standard)
◯ FB - Finelite Black [6]
◯ SA - Satin Aluminum [6]
◯ #### - RAL Color Code [6]
_____

Emergency Style (Optional)

◯ FAC CHO - Factory Choice Battery Back-up
◯ EM/GEN - Emergency to Generator
◯ NL - Night Light
◯ BSL310LP - Bodine Battery Back up Low Profile
◯ GTD - Generator Transfer Device
◯ ALCR - Automatic Load Control Relay

Integrated Sensor (Optional)

◯ OBO - Occupancy [7]
◯ OBD - Daylight [7]
◯ OBE - Enlighted [8]
◯ W601 - Wattstopper [9] Wireless Sensor
◯ REE - Remote Enlighted [10]

Special Options (Optional)

◯ CP - Chicago Plenum
◯ FLX - Flex Whip
◯ RLA - Red List Approved
◯ RLD - Declared

[1] Recessed Regressed straight run only
[2] Contact factory for switching options
[3] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[4] Not available with Regressed or Curves
[5] B & V outputs only
[6] 20 business days lead time for color
[7] Not available with Wall Wash
[8] Enlighted components installed by Finelite, provided by others
[9] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.
[10] Enlighted for Wall Wash fixtures. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor.

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Recessed

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Recessed

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS [1] : Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, 1" Drop Down Lens, Regressed Diffuser, or White Cross Blade Baffle [2]. Corners not available with Wall Wash (**WW-D**), Hollowed Ellipse Louver (**LHE**) or Hex Louver (**LHC**). Contact factory for Double miters using the White Cross Blade Baffle. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), Bottom Glow **(BG**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**) [3,4], Ellipse Louver (**LHE**) [3], Hex Louver (**LHC**) [3], Downlight Asymmetric Optic (**DAO**) [5], Downlight Spread Optic (**DSO**) [5], and Regressed downlight diffusers (**RG**) [3]. 1" Drop Down Lens made of highly efficient acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Spread & Downlight Asymmetric Optics are extruded lenses with a subtle ribbed appearance providing a batwing or asymmetric distribution for improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint. The standard Semi-Specular Aluminum (**SSA**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed wire controlling uplight and downlight together (power and dimming). Specify dual feed wires for independent control of uplight and downlight. 14-gauge feed wire used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.

- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:

- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))
- **LUT-2W (LTEA2W)** - (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.

- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime:** 100,000 hours
- **FineTune DMX:** 1%

LUTRON TUNABLE WHITE DRIVER OPTION:

LUT-TW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

[1] Not available with Wall Wash
[2] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[3] Recessed Regressed straight run only
[4] White Cross Blade Baffle (WCB) currently not advisable for drywall
[5] Not available with Regressed or Curves

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Recessed

SPECIFICATIONS

MOUNTING OPTIONS

HANGING HARDWARE:

- Recessed T-Bar: Standard bracket design works with most lay-in ceiling types. Brackets secure luminaire to the ceiling grid from above. Tie-in T-Bar brackets connect the luminaire to the T-Bar for securing to structure. Consult local codes for tie-wire recommendations.
- Recessed Spackle Flange: Drywall surfaces (walls or ceilings): 1/4" - 20 stud and nut (provided by others). Mounted with three equidistant suspension points.

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER OPTIONS

ENDCAPS: Flat endcaps (**FE**) at each end of run add 1/16" to each end of luminaire. Drop Down Lens Illuminated Endcap (**DE**) includes diffuse element to continue luminance of drop lens.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery		
	Factory Choice	Bodine BSL310LP
HP2-R-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	1608	956
EM Section Illuminated	2'	2' or 4'
HP2-R-WW-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	1500	891
EM Section Illuminated	4'	4'

* Minimum fixture housing length for battery pack approved without sensor

TUNABLE WHITE ELECTRICAL OPTIONS [6]:

- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) occupancy or daylight sensors available with Flush and Bottom Glow downlight diffusers. Refer to Occupancy Sensor, Daylight Sensor, and Enlighted Sensor tech sheets for more info.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**) [7], and Satin Aluminum (**SA**) [7] are standard. Optional Adder: 185 RAL colors [7] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These fixtures are rated for Damp Location. IC Rated. HP-2 can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT [8]: R - 2.3 lb/ft; WW-R - 2.9 lb/ft

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

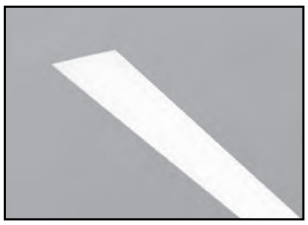
[6] Consult Finelite for Generator Transfer Device and Battery Backup fit
[7] 20 business days lead time for color
[8] Excludes Battery Backup and Generator Transfer Device weight

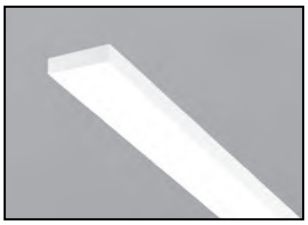
Submitted by:	Date:
Type:	Project:
Ordering Info:	

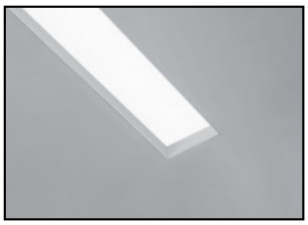
FINELITE® Better Lighting

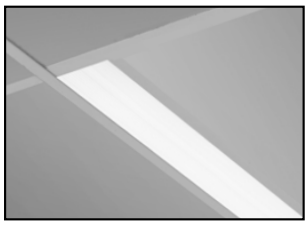
High Performance 2" Aperture (HP-2) Recessed

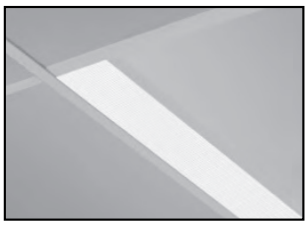
AESTHETIC OPTIONS

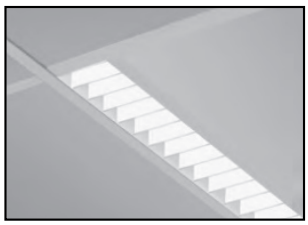

Flush Diffuser (**F**)

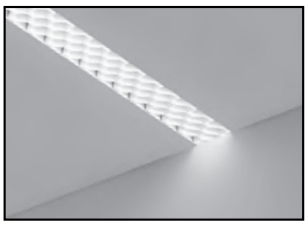

1" Drop Down Lens (**DL**)

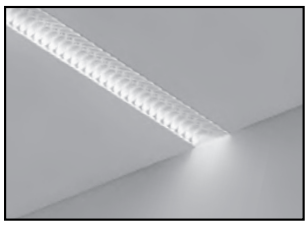

Flat Diffuser with 1" Regressed (**RG-D**)

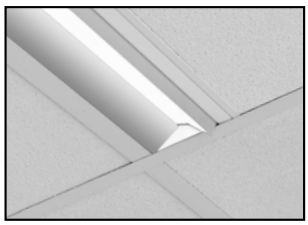

Downlight Asymmetric Optic (**DAO**) [1]
Externally flush


Downlight Spread Optic (**DSO**) [1]
Externally flush


White Cross Blade Baffle [2] (**RG-WCB**)


Hex Louver [2] (**RG-LHC**)


Hollowed Ellipse Louver [2] (**RG-LHE**)

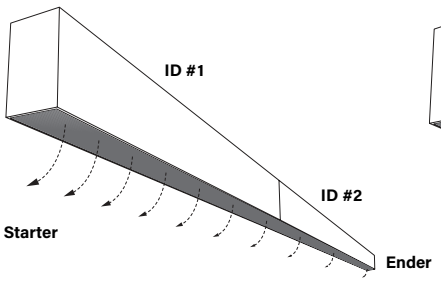

Kicker (**K**) - Wall Wash only

[1] With a subtle ribbed appearance providing specialized distribution
[2] Regressed only. Not available with Wall Wash

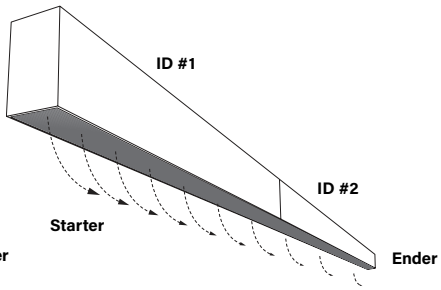
DOWNLIGHT ASYMMETRIC OPTIONS

Use this tool to understand how to specify Downlight Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify DAO-L distributes light to the left or DAO-R distributes light to the right.

Downlight Asymmetric Optic Left (DAO-L)



Downlight Asymmetric Optic Right (DAO-R)



PREINSTALLED LABEL

For DAO, Preinstalled label on diffuser shows direction of light. Remove after installation.

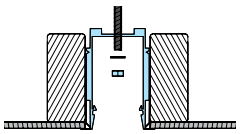
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

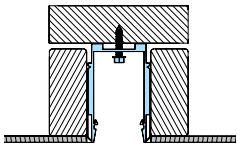
High Performance 2" Aperture (HP-2) Recessed

HARD CEILING MOUNTING OPTIONS

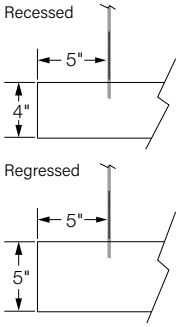
Threaded Rod Option



Screw Mount Option

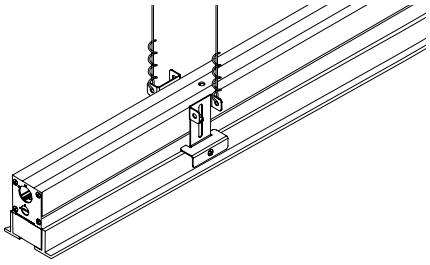


Mounting Location for Securing to Structure



Two mounting options: threaded rod and screw mounting options. Mounting locations are located on each end of the luminaire. Mounting location is 5" away from each end of luminaire.

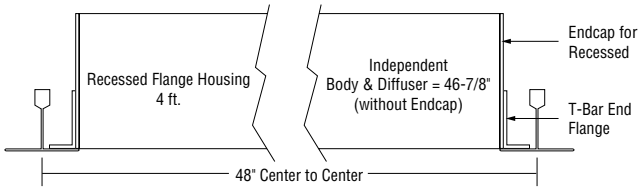
T-BAR INSTALLATION



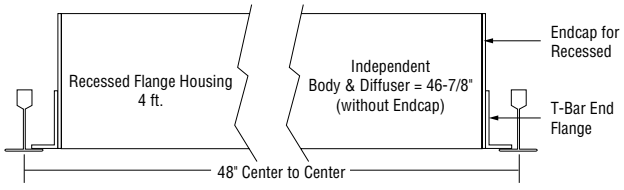
HP-2 R for T-Bar installations comes standard with a splice plate at the end of the luminaire. Mounting brackets (supplied) secure the luminaire to T-Bar and provide support to structure location. All even foot length (2, 4, 6, ...) luminaire runs are reduced in length by an appropriate amount to fit within typical 2x2 and 2x4 T-Bar grid systems. For uncommon T-Bar systems please consult factory.

GRID LENGTH DETAIL - 4' EXAMPLE

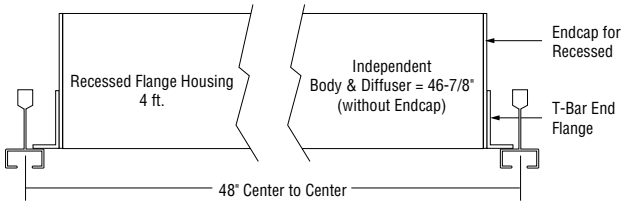
1" T-Bar



9/16" T-Bar

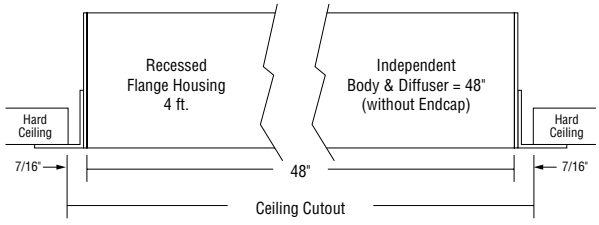


9/16" Screw Slot

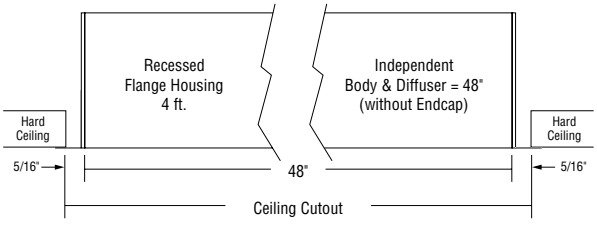


HARD CEILING LENGTH DETAIL - 4' EXAMPLE

Spackle Flange



Visible Flange



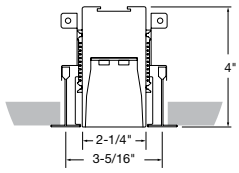
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

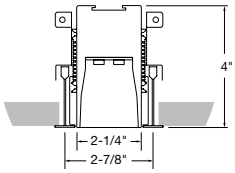
High Performance 2" Aperture (HP-2) Recessed

RECESSED MOUNTING TYPES - T-BAR

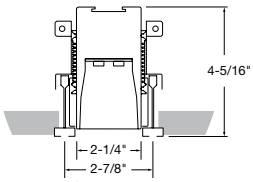
Rough-In Dimensions



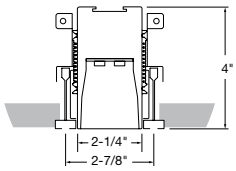
1" T-Bar (C1)



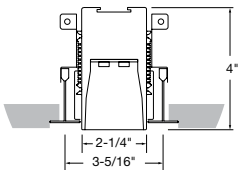
9/16" T-Bar (C2)



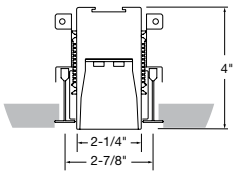
Standard Screw Slot (C3)



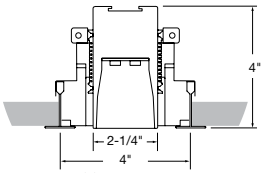
Flush Screw Slot (C3F)



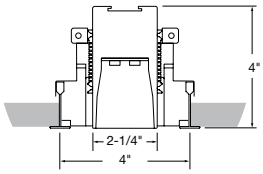
1" Tegular (C1T)



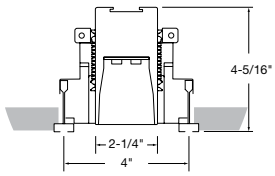
9/16" Tegular (C2T)



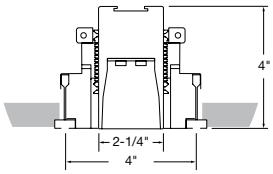
Tech Zone 4" (TZ4)
1" T-Bar (C1)



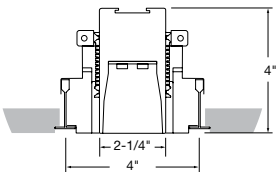
Tech Zone 4" (TZ4)
9/16" T-Bar (C2)



Tech Zone 4" (TZ4)
Standard Screw Slot (C3)

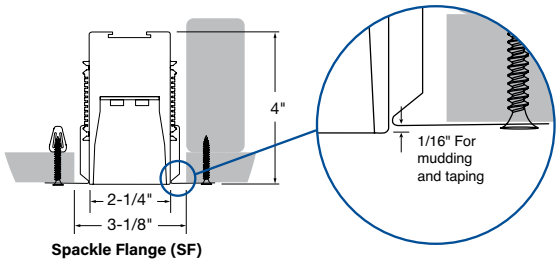


Tech Zone 4" (TZ4)
Flush Screw Slot (C3F)

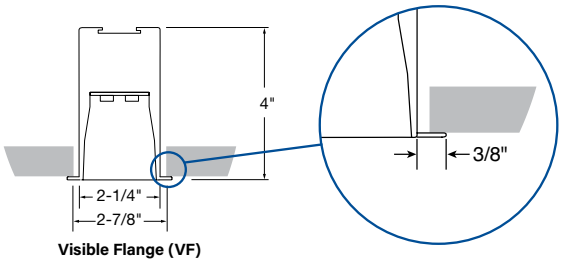


Tech Zone 4" (TZ4)
9/16" Tegular (C2T)

RECESSED MOUNTING TYPES - CUTOUT DIMENSIONS



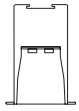
Spackle Flange (SF)



Visible Flange (VF)

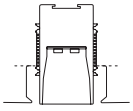
HOUSING

Version 1



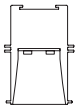
Ceiling Option VF

Version 2



Ceiling Options
C1T, C2T, C3F, SF, TZ4

Version 3



Ceiling Options
C1, C2, C3

Note: +/- 1/16"

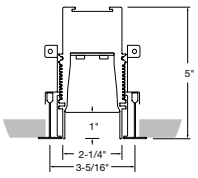
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

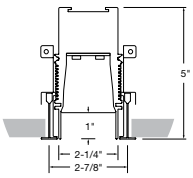
High Performance 2" Aperture (HP-2) Recessed

REGRESSED MOUNTING TYPES - T-BAR

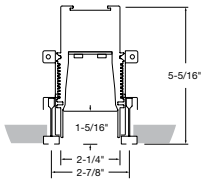
Rough-In Dimensions



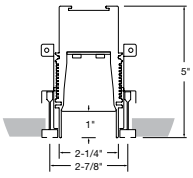
1" T-Bar (C1)



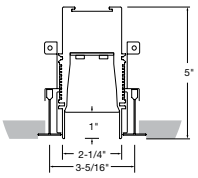
9/16" T-Bar (C2)



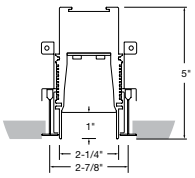
Standard Screw Slot (C3)



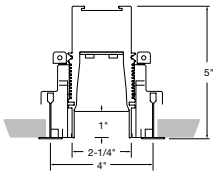
Flush Screw Slot (C3F)



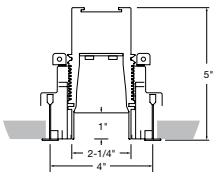
1" Tegular (C1T)



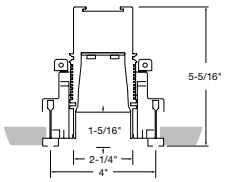
9/16" Tegular (C2T)



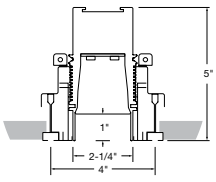
Tech Zone 4" (TZ4)
1" T-Bar (C1)



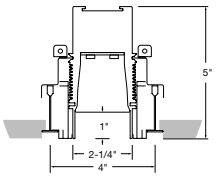
Tech Zone 4" (TZ4)
9/16" T-Bar (C2)



Tech Zone 4" (TZ4)
Standard Screw Slot (C3)

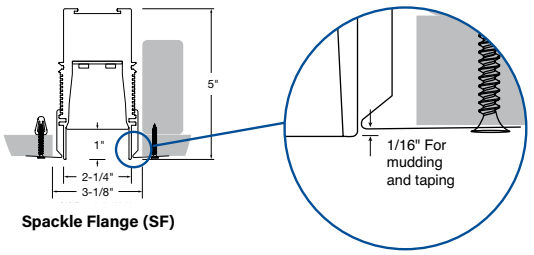


Tech Zone 4" (TZ4)
Flush Screw Slot (C3F)

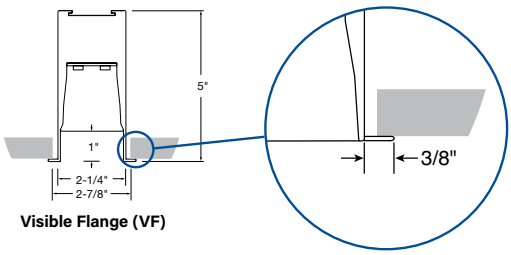


Tech Zone 4" (TZ4)
9/16" Tegular (C2T)

REGRESSED MOUNTING TYPES - CUTOUT DIMENSIONS



Spackle Flange (SF)

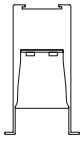


Visible Flange (VF)

Regressed Lens: Regressed lens version is 5" tall with a lens that is regressed 1" from ceiling line.

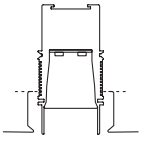
HOUSING

Version 1



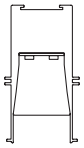
Ceiling Option VF

Version 2



Ceiling Options
C1T, C2T, C3F, SF, TZ4

Version 3



Ceiling Options
C1, C2, C3

Note: +/- 1/16"

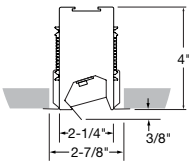
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

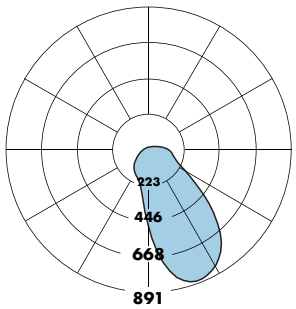
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Recessed

Wall Wash Recessed - 4' Luminaire 3500K

HP2-R-WW-D-K-4'-V-835
Downlight: With Kicker





CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	FLUX
0	485	485	485	485	485	
5	652	606	483	378	342	47
15	863	790	470	251	219	145
25	882	829	442	201	184	231
35	795	764	397	168	152	282
45	581	629	333	133	105	277
55	326	436	251	86	62	217
65	196	250	167	43	24	144
75	158	145	88	7	0	87
85	124	97	24	0	0	50
90	93	68	0	0	0	

Efficacy: 76 lm/W
Total luminaire output: 1500 lumens (375 lm/ft)
19.6 watts (4.9 W/ft)
Peak Candela Value: 882 @ 25º
CRI: 80 / CCT: 3500K
ITL LM79 Report 85137

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B [1]**	**H [1]**	**V [2]**
614	772	1167	1500

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
154	193	292	375

Power, 3500K (Watts Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
2.0	2.5	3.8	4.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B [1]**	**H [1]**	**V [2]**
76	77	77	77

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 1167 lm x 0.789 = 921 lm

Total Light Output per Foot: 292 lm/ft x 0.789 = 230 lm/ft.

watts/foot: 3.8 W/ft.

$$\textbf{Efficacy} = \frac{230\ \frac{\text{lm}}{\text{ft.}}}{3.8\ \frac{\text{W}}{\text{ft.}}} = 61\ \text{lm/W}$$

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85137

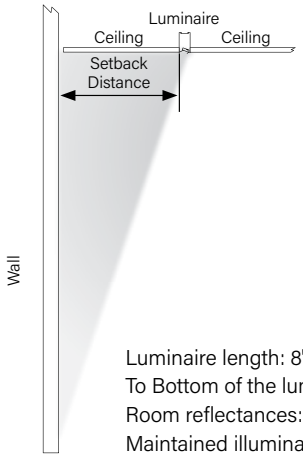
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Recessed

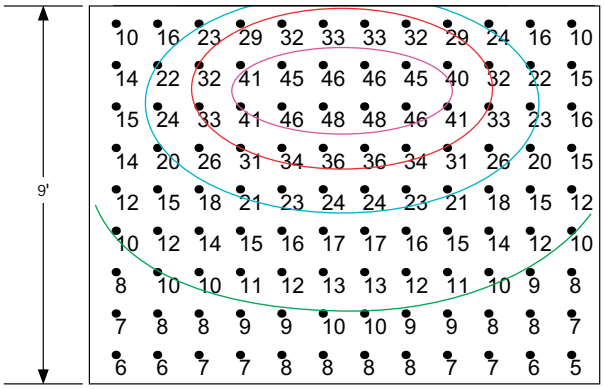
WALL WASH RECESSED - SETBACK INFO AND APPLICATION DATA

HP2-R-WW-D-K-4'-V-835
Downlight: With Kicker
Total luminaire output: 1500 lumens (375 lm/ft)
19.6 watts (4.9 W/ft)
CRI: 80 / CCT: 3500K



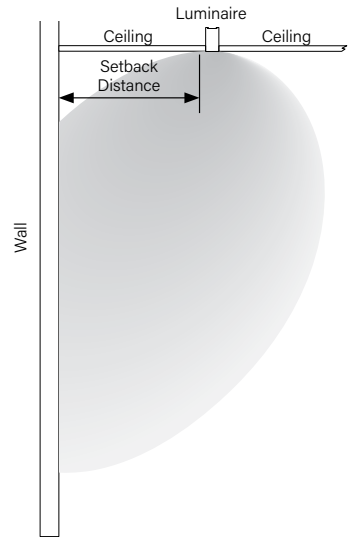
Luminaire length: 8'
To Bottom of the luminaire: 9'-0"
Room reflectances: 80-50-20
Maintained illuminance levels: LLF 0.86"

Setback Distance - 2'

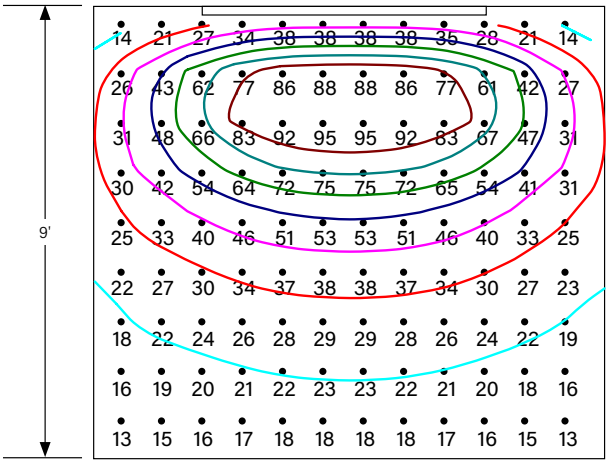


DOWNLIGHT ASYMMETRIC OPTIC - SETBACK INFO AND APPLICATION DATA

HP2-R-D-4ft-V-835-DAO
Downlight: DAO
Total luminaire output: 3742 lumens (936 lm/ft)
35.6 watts (8.9 W/ft)
CRI: 80 / CCT: 3500K



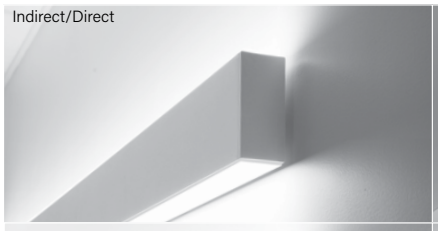
Setback Distance - 2'

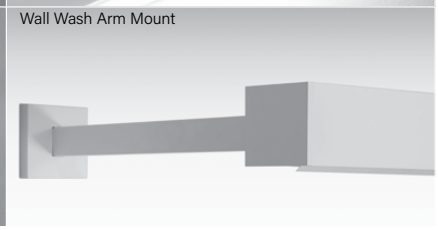


Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount





High Performance 2" Aperture is a patented, linear LED luminaire family. HP-2 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

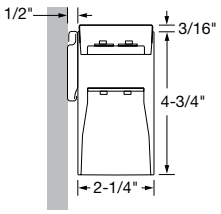
This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

Signal White is standard finish

Note: see page 6 for all aesthetic options

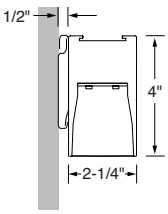
CROSS SECTIONS

Indirect/Direct
Top Glow Diffuser (standard)



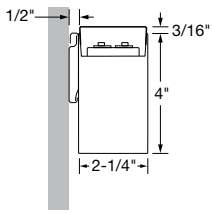
Flush Downlight Diffuser (standard)

Direct

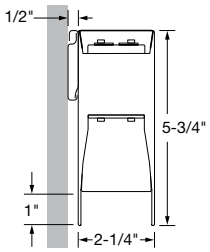


Flush Downlight Diffuser (standard)

Indirect
Top Glow Diffuser (standard)

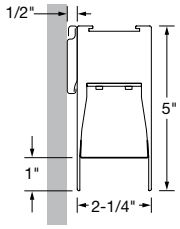


Indirect/Direct Regressed
Top Glow Diffuser (standard)



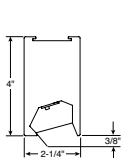
Flat Diffuser with 1" Regress (standard)

Direct Regressed

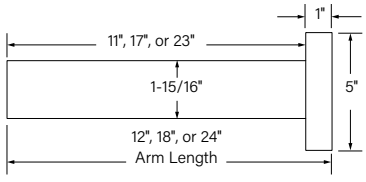


Flush Downlight Diffuser (standard)

Wall Wash Arm Mount



Kicker (standard)



ALSO AVAILABLE IN

Pendant (**D, ID, I**)

Recessed (**R**)

Surface Mount (**SM**)

Also available in Indigo-Clean. See Indigo-Clean Tech Sheet

A brand of legrand

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

Clear Form

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	◉ 2	◯ WM - Wall Mount [1] ◯ WM RG - Wall Mount Regressed [1] ◯ AM - Arm Mount	◯ D - Direct ◯ WW-D - Wall Wash Direct ◯ ID - Indirect/Direct ◯ I - Indirect	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT AND LED TYPE

Uplight Output ID & I Only (Flush)
◯ S - Standard (393 lm/ft) ◯ B - Boosted (494 lm/ft) ◯ H - High (747 lm/ft) ◯ V - Very High (961 lm/ft) ◯ TL - Tailored:_____lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

OUTPUT AND LED TYPE

Downlight Output ID & D Only (Flush)	LED CRI/CCT
◯ S - Standard (322 lm/ft) ◯ B - Boosted (405 lm/ft) ◯ H - High (612 lm/ft) ◯ V - Very High (786 lm/ft) ◯ TL - Tailored:_____lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of these range.	◯ 830 - 80 CRI, 3000K ◯ 835 - 80 CRI, 3500K ◯ 840 - 80 CRI, 4000K ◯ 930 - 90 CRI, 3000K ◯ 935 - 90 CRI, 3500K ◯ 940 - 90 CRI, 4000K ◯ 8TW - 80 CRI, Tunable White ◯ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Uplight	Downlight	Reflector System
◯ TG - Top Glow (standard) ◯ F - Flush ◯ ASY-L - Asymmetric Left Optic ◯ ASY-R - Asymmetric Right Optic ◯ ASYTG-L - Asymmetric Left Optic with Top Glow ◯ ASYTG-R - Asymmetric Right Optic with Top Glow	◯ F - Flush (standard) [1] ◯ BG - Bottom Glow [1] ◯ DL - 1" Drop Down Lens [2] ◯ RG-D - Flat Diffuser with 1" Regress [1,2] ◯ RG-WCB - White Cross Blade Baffle [1,2] ◯ RG-LHE - Hollowed Ellipse Louver [1,2] ◯ RG-LHC - Hex Louver [1,2] ◯ DAO-L - Downlight Asymmetric Optic Left [3] ◯ DAO-R - Downlight Asymmetric Optic Right [3] ◯ K - Kicker for Wall Wash only (standard) ◯ FO - Fully Open for Wall Wash only	◯ 96LG - 96 Low Gloss White ◯ SW - Signal White for Wall Wash only

ELECTRICAL OPTIONS

Voltage	Circuiting [4]	Driver Selection
◯ 120 - 120 Voltage ◯ 277 - 277 Voltage ◯ 347 - 347 Voltage	◯ SC - Single Circuit* One single circuit in a run ◯ DC - Dual Circuit* [5] Independent control of up and down separately in an I/D style fixture ◯ MC - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required * Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)	**0-10V Driver Options** ◯ FC-10% - 0-10V 10% [6] (standard) ◯ FC-1% - 0-10V 1% [6] ◯ OSR-10% - Osram OTi, 0-10V 10% [6] ◯ OSR-1% - Osram OTi, 0-10V 1% [6] ◯ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1% ◯ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [6] **DALI Driver Options** ◯ FC-DALI-1% - DALI 1% ◯ OSR-DALI-1% - Osram Dexal, 1% ◯ ELD-DALI-0% - EldoLED SOLOdrive, 0.1% ◯ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)* **DMX Driver Options** ◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [7] ◯ ELD-DMX - EldoLED POWERdrive, 0.1% ◯ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)* **Lutron Driver Options** ◯ LUT-ES1 - Lutron, Ecosystem 1% ◯ LUT-2W - Lutron, 2-wire (120V only) 1% ◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)* See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method	Endcap Style	Finish
◯ MB - Mounting Bracket [8] ◯ AM12 - 12" [9] ◯ AM18 - 18" [9] ◯ AM24 - 24" [9]	◯ FE - Flat Endcap (standard) ◯ DE - 1" Drop Endcap [10] ◯ OE - Open Endcap [11]	◯ SW - Signal White (standard) ◯ FB - Finelite Black [12] ◯ SA - Satin Aluminum [12] ◯ #### - RAL Color Code [12] _____

OTHER OPTIONS

Emergency Style (Optional)	Integrated Sensor (Optional)	Special Options (Optional)
◯ FAC CHO - Factory Choice Battery Back-up ◯ EM/GEN - Emergency to Generator ◯ NL - Night Light ◯ BSL310LP - Bodine Battery Back up Low Profile ◯ GTD - Generator Transfer Device	◯ OBO - Occupancy [1] ◯ OBD - Daylight [1] ◯ OBE - Enlighted [1,13] ◯ W601 - Wattstopper [14] Wireless Sensor ◯ REE - Remote Enlighted [15]	◯ RLA - Red List Approved ◯ RLD - Declared

[1] Not available for Wall Wash
[2] D & ID Regressed only
[3] Not available with regressed
[4] Contact factory for switching options
[5] Indirect/Direct only
[6] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[7] B & V outputs only
[8] Wall Mount only
[9] Arm Mount only
[10] 1" Drop Down Lens downlight only
[11] Available with Hollowed Ellipse Louver (**LHE**) only
[12] 20 business days lead time for color
[13] Enlighted components installed by Finelite, provided by others
[14] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.
[15] Enlighted for Wall Wash fixtures. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS[1]: Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, 1" Drop Down Lens[2], Regressed Diffuser, or White Cross Blade Baffle[3]. Corners not available with Wall Wash (**WW-D**), Hollowed Ellipse Louver (**LHE**) or Hex Louver (**LHC**). Contact factory for Double miters using the White Cross Blade Baffle. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

UPLIGHT OPTION[4]: Patented Top Glow frost white diffuser standard. 12' maximum diffuser length. 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination Optional: Flush frost white snap-in diffuser, 73% transmissive, 99% diffusion; **ASY-L** distributes light to the left, **ASY-R** distributed light to the right of the luminaire. Consult factory for more tailored lumen outputs.

DOWNLIGHT OPTION[5]: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), Bottom Glow (**BG**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**)[6], Hollowed Ellipse Louver (**LHE**)[6], Hex Louver (**LHC**)[6], Downlight Asymmetric Optic (**DAO**)[7], and Regressed downlight diffusers (**RG**). 1" Drop Down Lens made of highly efficient acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Asymmetric Optic is an extruded lens with a subtle ribbed appearance providing an asymmetric distribution for improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Wall Mount: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white power coat paint. **Arm Mount**: The standard Signal White (**SW**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL FEATURES

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed controlling uplight and downlight together (power and dimming). Specify dual feeds for independent control of uplight and downlight. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:
- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))
- **LUT-2W (LTEA2W)** - (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime.:** 100,000 hours
- **FineTune DMX:** 1%

[1] Not available with Wall Wash
[2] Indirect/Direct and Direct only
[3] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[4] Wall Mount Indirect/Direct, Wall Mount Regressed Indirect/Direct, and Wall Mount Indirect only
[5] Wall Mount Indirect/Direct, Wall Mount Regressed Indirect/Direct, Wall Mount Direct, and Wall Mount Regressed Direct only
[6] Wall Mount Regressed Indirect/Direct & Wall Mount Regressed Direct only
[7] Not available with Regressed

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SPECIFICATIONS

LUTRON TUNABLE WHITE DRIVER OPTION: LUT-TW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE: Wall Mount: Luminaire hangs securely from mounting brackets fastened directly to the wall for easy installation. Luminaire stands 1/2" off the wall. The mounting bracket is concealed behind the luminaire. **Arm Mount**: bracket mounts directly to wall j-box, extends luminaire 12", 18", or 24" from wall. Other lengths available. Consult factory.

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of luminaire runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER OPTIONS

ENDCAPS: Flat diecast aluminum endcaps (**FE**) add 1/4" to each end of luminaire. 1" Drop Down Lens Endcap (**DE**)[8] includes diffuse element to continue luminance of drop lens. Open Endcap (**OE**) is for use with the Hollowed Ellipse Louver (**LHE**); following the curve of the louver.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery. Factory choice low-profile backup battery available. 8' minimum luminaire length for low profile battery pack.
- **Indirect/Direct:** backup batteries deliver 1608 lumens. 12' minimum luminaire length. 2' illuminated (downlight standard).
- **Direct:** backup batteries deliver 1608 lumens. 8' minimum luminaire length. 2' illuminated.
- **Indirect:** backup batteries deliver 1874 lumens. 8' minimum luminaire length. 2' illuminated.
- **Wall Wash:** backup batteries deliver 1500 lumens. 8' minimum luminaire length. 2' illuminated.

Tunable White ELECTRICAL OPTIONS[9]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) occupancy or daylight sensors available with Flush and Bottom Glow downlight diffusers. Refer to Occupancy Sensor, Daylight Sensor, and Enlighted Sensor tech sheets for more info.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**)[10], and Satin Aluminum (**SA**)[10] are standard. Optional Adder: 185 RAL colors[10] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These fixtures are rated for Damp Location. HP-2 can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT[11]: ID - 2.9 lb/ft; D - 2.3 lb/ft; I - 2.3 lb/ft; AM - 2.9 lb/ft (luminaire only)

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

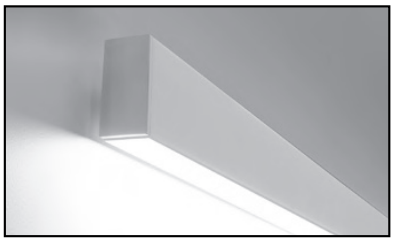
[8] Available in Indirect/Direct Regressed & Direct Regressed only
[9] Consult Finelite for Generator Transfer Device and Battery Back up fit
[10] 20 business days lead time for color
[11] Excludes Battery Back up and Generator Transfer Device weight

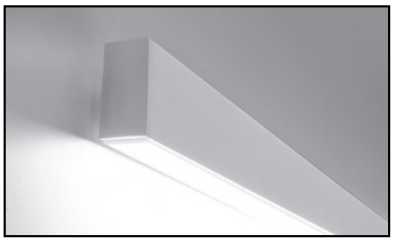
Submitted by:	Date:
Type:	Project:
Ordering Info:	

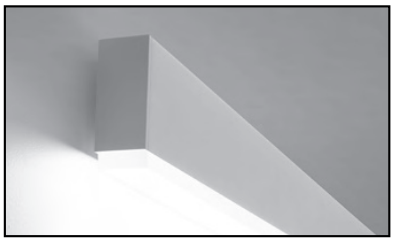
FINELITE® Better Lighting

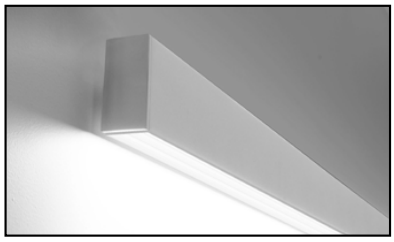
High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

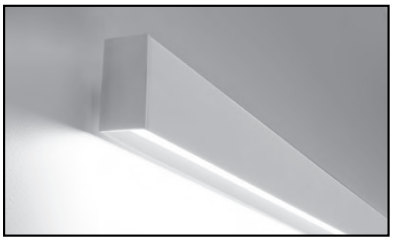
AESTHETIC OPTIONS

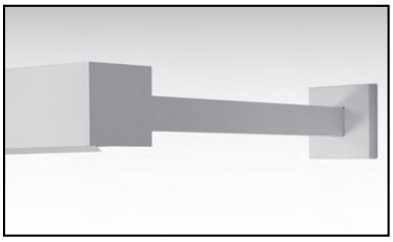

Flush Diffuser (**F**)

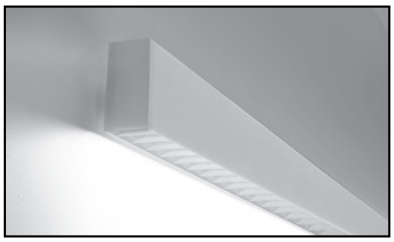

Bottom Glow Diffuser (**BG**)

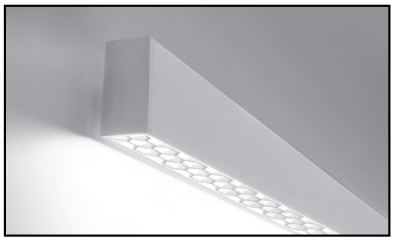

1" Drop Down Lens (**DL**)

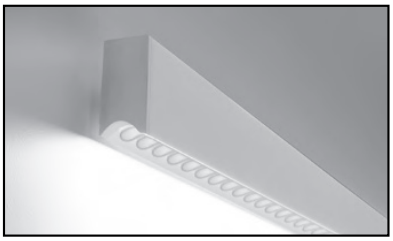

Downlight Asymmetric Optic (**DAO**)[1]
Externally flush


Flat Diffuser with 1" Regressed (**RG-D**)


Kicker (**K**) - Wall Wash Arm Mount only


White Cross Blade Baffle[2] (**RG-WCB**)


Hex Louver[2] (**RG-LHC**)


Hollowed Ellipse Louver[2] (**RG-LHE**)

[1] With a subtle ribbed appearance providing an asymmetric distribution
[2] Regressed only

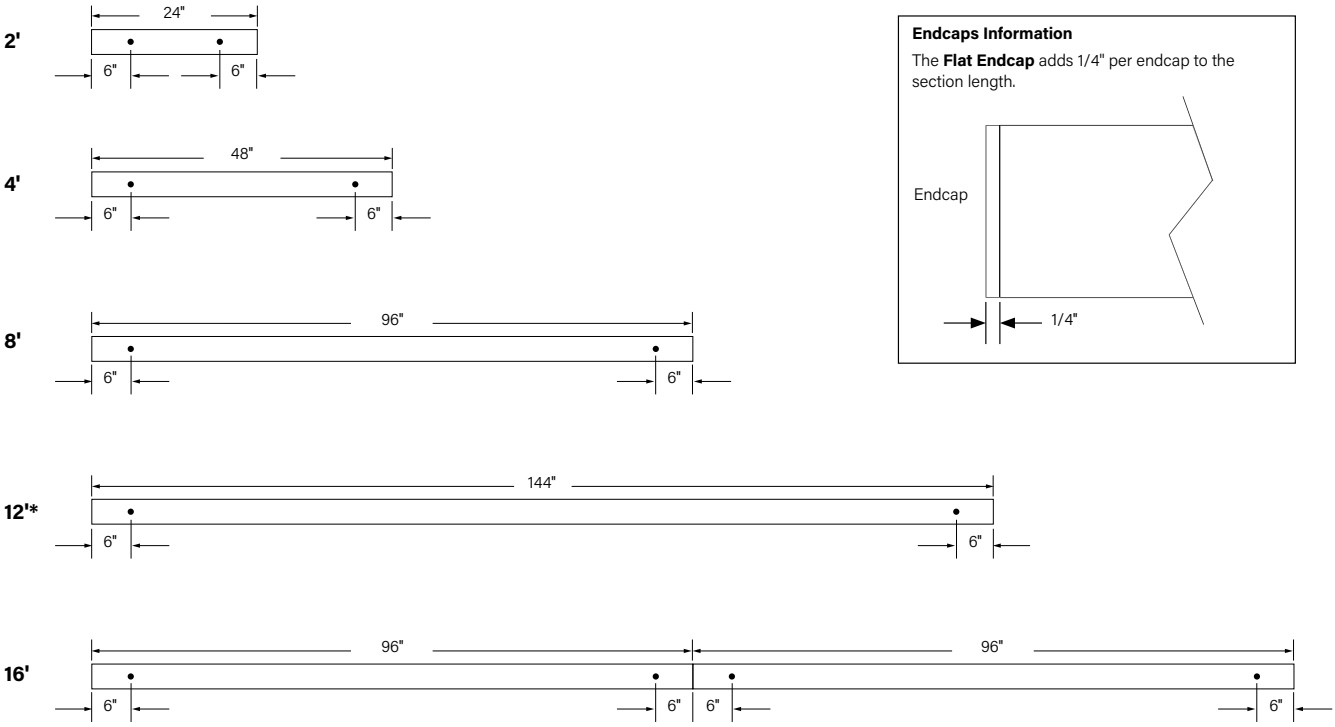
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

WALL WASH ARM MOUNT - Run Lengths & Mounting Location Examples

Tailored Lengths Available Down To 1/16" (±1/32")



Endcaps Information

The **Flat Endcap** adds 1/4" per endcap to the section length.

• = Bracket Location
* = 12' Maximum spacing for two Arm Mount supports

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

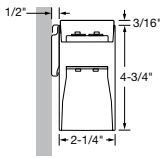
FINELITE® Better Lighting

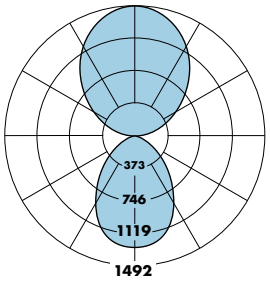
High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

Indirect/Direct Photometry - 4' Luminaire 3500K

HP2-WM-ID-4'-V-V-835
Uplight: Flush Diffuser / **Downlight:** Flush Diffuser

Distribution: 55% Up (**V**) / 45% Down (**V**)
Efficacy: 95 lm/W
Uplight: 3813 lumens (953 lumens/foot)
Downlight: 3175 lumens (794 lumens/foot)
Total luminaire output: 6988 lumens (1747 lm/ft)
73.8 watts (18.5 W/ft)
Peak Candela Value: 1492 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85132





CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	FLUX
0	1314	1314	1314	1314	1314	
5	1306	1307	1305	1304	1304	124
15	1241	1233	1231	1225	1220	346
25	1114	1098	1089	1076	1064	501
35	942	925	910	887	877	568
45	749	734	718	693	683	552
55	553	542	526	506	499	470
65	368	360	349	337	332	346
75	203	198	192	187	184	204
85	60	59	58	57	55	64
90	0	0	0	0	0	
95	71	68	68	69	70	77
105	244	241	236	235	234	252
115	442	439	437	427	425	431
125	661	649	653	643	638	581
135	884	871	875	866	866	673
145	1099	1084	1088	1084	1077	679
155	1283	1268	1275	1269	1263	585
165	1415	1405	1408	1406	1403	396
175	1482	1482	1482	1482	1481	141
180	1492	1492	1492	1492	1492	

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	2861 [↑55% I 45%↓]	3262 [↑60% I 40%↓]	4265 [↑70% I 30%↓]	5113 [↑75% I 25%↓]
↓B [1]	3195 [↑49% I 51%↓]	3596 [↑55% I 45%↓]	4600 [↑65% I 35%↓]	5447 [↑70% I 30%↓]
↓H [1]	4030 [↑39% I 61%↓]	4432 [↑44% I 56%↓]	5435 [↑55% I 45%↓]	6282 [↑61% I 39%↓]
↓V [2]	4736 [↑33% I 67%↓]	5137 [↑38% I 62%↓]	6141 [↑48% I 52%↓]	6988 [↑55% I 45%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	715	815	1066	1278
↓B [1]	799	899	1150	1362
↓H [1]	1008	1108	1359	1571
↓V [2]	1184	1284	1535	1747

Power, 3500K (Watts Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.2	8.2	10.7	12.8
↓B [1]	8.2	9.2	11.7	13.8
↓H [1]	10.7	11.7	14.2	16.3
↓V [2]	12.8	13.8	16.3	18.5

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	99	99	100	100
↓B [1]	97	98	99	99
↓H [1]	94	95	96	96
↓V [2]	92	93	94	95

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 4265 lm x 0.789 = 3365 lm

Total Light Output per Foot: 1066 lm/ft x 0.789 = 841 lm/ft.

watts/foot: 10.7 W/ft.

$$\textbf{Efficacy} = \frac{841\ \frac{\text{lm}}{\text{ft.}}}{10.7\ \frac{\text{W}}{\text{ft.}}} = 79\ \text{lm/W}$$

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85132

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

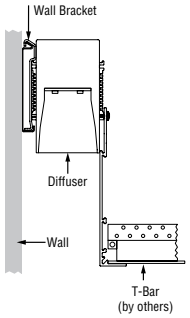
HP-2 WS Perimeter Slot provides ultimate flexibility for perimeter lighting with exact fit tailored lengths or optional adjustable telescoping sections. Prebuilt, fully-illuminated 90° inside and outside corners add to its clean aesthetics. HP-2 WS Perimeter Slot delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components. An all-in-one box shipping approach to reduce labor and streamline installation.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving Red List Approved and Declared status.

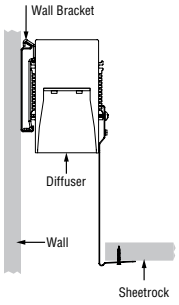
Note: see page 6 for all aesthetic options

CROSS SECTIONS

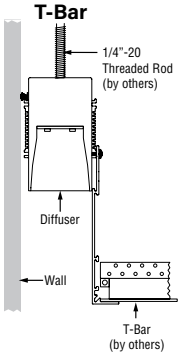
Wall Mount T-Bar



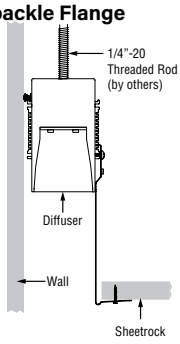
Wall Mount Spackle Flange



Threaded Rod T-Bar

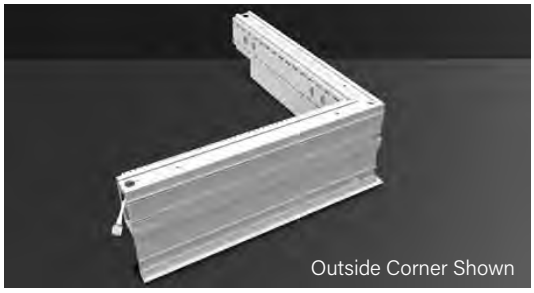


Threaded Rod Spackle Flange

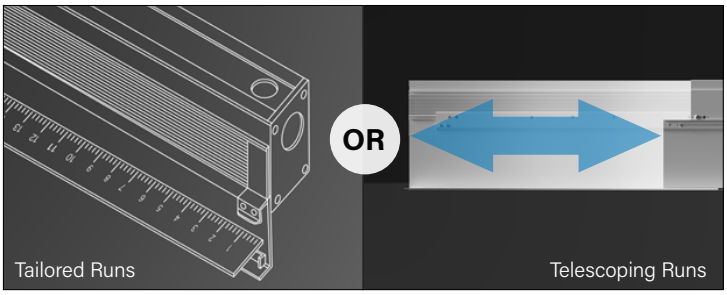


FEATURES

Fully illuminated, factory built all-in-one box shipping plug-together inside and outside corners for easy installation.



Provide exact wall dimensions and we will deliver precisely down to 1/16" or optional adjustable telescoping (**TXL**) sections adaptable to on-site dimension.



INDUSTRY BEST 10 YEAR LED WARRANTY

Fine TUNE GENERATION 1 Option Available

Declare. Third Party Verified

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

Clear Form

Ordering Sample: HP-2 WS-4D-24'-B-835-96LG-277-SC-FC-10%-WB-C1-FE-L-FE-R-SW

BODY TYPE

Platform	Series Name	Regressed Optic Depth	Total Length of Run
◉ HP - High Performance	◉ 2 WS	◉ 4D - 4" Depth	For configurations provide nominal total length. Actual length calculated by factory. Please provide drawings to clearly illustrate corners and wall dimensions _____ **Tailored Runs:** Minimum 2' section length. Increments accurate to 1/16" (±1/32), standard. 12' maximum section length. **TXL Runs:** Optional TXL adds 1" to run length and up to an additional 11" of fully illuminated adjustability. Minimum length with TXL: 4'-1" with Std. Osram drivers or 5'-1" with all other drivers. Max single section length with TXL adjustable from 11'-1" to 12'-0".

OUTPUT AND LED TYPE

Downlight Output	LED CRI/CCT
○ S - Standard (326 lm/ft) ○ B - Boosted Standard (410 lm/ft) ○ H - High (619 lm/ft) ○ V - Very High (796 lm/ft) ○ TL - Tailored:_____lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.	○ 830 - 80 CRI, 3000K ○ 835 - 80 CRI, 3500K ○ 840 - 80 CRI, 4000K ○ 930 - 90 CRI, 3000K ○ 935 - 90 CRI, 3500K ○ 940 - 90 CRI, 4000K ○ 8TW - 80 CRI, Tunable White ○ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Reflector System	Voltage	Circuiting[1]
○ 96LG - 96 Low Gloss White	○ 120 - 120 Voltage ○ 277 - 277 Voltage ○ 347 - 347 Voltage	○ SC - Single Circuit* One single circuit in a run ○ MC - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required * Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS

Driver Selection

0-10V Driver Options
- ○ FC-10% - 0-10V 10%[2] (standard)
- ○ FC-1% - 0-10V 1%[2]
- ○ OSR-10% - Osram OTi, 0-10V 10%[2]
- ○ OSR-1% - Osram OTi, 0-10V 1%[2]
- ○ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%
- ○ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)*[2]

DALI Driver Options
- ○ FC-DALI-1% - DALI 1%
- ○ OSR-DALI-1% - Osram Dexal, 1%
- ○ ELD-DALI-0% - EldoLED SOLOdrive, 0.1%
- ○ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*

DMX Driver Options
- ○ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)*[3]
- ○ ELD-DMX - EldoLED POWERdrive, 0.1%
- ○ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options
- ○ LUT-ES1 - Lutron, Ecosystem 1%
- ○ LUT-2W - Lutron, 2-wire (120V only) 1%
- ○ LUT-TW - Lutron T-Series, 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method	Ceiling Hardware Type *
○ TR - Threaded Rod Ideal for Post-Ceiling installation ○ WB - Wall Bracket Ideal for Pre-Ceiling installation	○ C1 - 1" T-Bar ○ C2 - 9/16" T-Bar ○ C3 - Screw Slot ○ SF - Spackle Flange ○ C1T - 1" Tegular ○ C2T - 9/16" Tegular * Compatible with all T-Bar type. T-Bar width provided is 15/16" wide.

OTHER OPTIONS

End Condition Left[4]	Middle Condition[4] (Optional)	End Condition Right[4]	Finish
◉ FE-L - Flat Endcap (standard) ○ PE-L - Pocket Slot ○ TXL-L* - Telescoping (End feed only) ○ PE-TXL-L* - Pocket Slot Telescoping	○ TXL-M* - Telescoping Middle (Not available for lengths less than 11ft) ○ None - None	◉ FE-R - Flat Endcap (standard) ○ PE-R - Pocket Slot ○ TXL-R* - Telescoping (End feed only) ○ PE-TXL-R* - Pocket Slot Telescoping	◉ SW - Signal White (standard)

* Just one optional TXL provides fully illuminated adjustability of up to 11". Choose TXL-L(Left), TXL-M (Middle), or TXL-R(Right).

OTHER OPTIONS

Emergency Style (Optional) Clear Selection	Remote Sensor (Optional) Clear Selection	Special Options (Optional) Clear Selection	Configuration Clear Selection
○ LGD18W - Legrand 18W Brand Battery Back-up ○ LGD10W - Legrand 10W Brand Battery Back-up ○ EM/GEN - Emergency to Generator ○ NL - Night Light ○ BSL310LP - Bodine Battery Back up Low Profile ○ GTD - Generator Transfer Device ○ ALCR - Automatic Load Control Relay	○ REE - Remote Enlighted[5,6]	○ CP - Chicago Plenum ○ FLX - Flex Whip ○ RLA - Red List Approved ○ RLD - Declared	○ CFG - Configuration Select CFG when specifying a run that has at least one corner. Please provide plan drawings to clearly communicate wall length dimensions.

[1] Contact factory for switching options
[2] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[3] B & V outputs only
[4] Telescoping can be Left, Middle, or Right. Left, Middle, and Right telescoping on the same body section is not available, consult factory if needed.
[5] Enlighted components installed by Finelite, provided by others
[6] Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming (LDE1)
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming (LTEA2W)
LUT-TW	Lutron T-Series, 0.1% Dimming, *Tunable White* (PSQ02U)

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Telescoping (**TXL**) Minimum run length with Std. Osram drivers: 4'-1" adjustable to 5'-0". Telescoping (**TXL**) Minimum run length with all other drivers: 5'-1" adjustable to 6'-0". Max single section length with TXL adjustable from 11'-1" to 12'-0". Just one optional TXL provides fully illuminated adjustability of up to 11". Choose TXL-L(Left), TXL-M (Middle), or TXL-R(Right).

PRE-BUILT 90 DEGREE CORNERS [1]: Fully illuminated 90 degree inside and outside corners available. Pre-built corners account for 2' of wall length for both inside and outside corners. Consult factory for non-90 degree corners.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION : 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 83% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint.

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed wire controlling downlight (power and dimming). 14-gauge feed wire used when luminaire current exceeds 5 amps. Telescoping section available with end feed only.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:
- **LUT-ES1 (LDE1)** (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series)) (LDE1)
- **LUT-2W (LTES2W)** (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)) (LTEA2W)

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime:** 100,000 hours
- FineTune DMX is 1%

LUTRON TUNABLE WHITE DRIVER OPTION:
LUT-TW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)). (PSQ02U)

MOUNTING OPTIONS

HANGING HARDWARE: Threaded Rod (TR) option eliminates the need to install luminaires prior to the slot be- ing framed. Luminaire mounts on threaded rods. Gasket runs length of luminaire ensuring a clean finish at the wall. Optional mounting includes a wall bracket that is attached to the wall. Luminaires are then snapped onto the bracket. Luminaire installation that uses the mounting bracket must be performed before the perimeter slot framing is built. Blocking may be required to properly secure and position the luminaire. Be sure to allow room for finished wall materials such as stone, tile etc. Refer to details on page 7.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of luminaire runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

SPECIFICATIONS

OTHER OPTIONS

END CONDITIONS: Flat end condition (**FE-L & FE-R**)[1] at each end of run add 1/8" to each end of luminaire and are used when luminaire terminates at a vertical surface such as a finished wall. Pocket slot end condition (**PE-L & PE-R**)[1] to end and are used when slot terminates before meeting additional vertical wall surface. Includes the necessary hardware to accommodate ceiling materials when the luminaire doesn't terminate at a wall. Adds 1-1/4" for Spackle Flange and 1" for T-Bar per endcap to overall length of the luminaire.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery				
	Legrand 10W		Bodine BSL310LP 4ft. & 6ft.+ is okay. 4.1~5.9 not okay.	
Min. Housing Length	8'*	10'* + TXL	4'*	6'* + TXL
EM Lumen Output	1608	1608	956	956
EM Section Illuminated	2'	2'	2' or 4'	2' or 4'

* Minimum luminaire housing length for battery pack approved without sensor

TUNABLE WHITE ELECTRICAL OPTIONS[6]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

REMOTE SENSORS: Remote mounted PIR (Passive Infrared) occupancy or daylight sensors available. Refer to Occupancy Sensor, Daylight Sensor, and Enlighted Sensor tech sheets for more info.

FINISHES: Finelite Signal White (**SW**) powder coat finish standard. Optional Adder: 185 RAL colors[2] are available. Custom color applies to the visible T-Bar flange.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These luminaires are rated for Damp Location. IC Rated. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT[8]: Wall Mount T-Bar: 4.6 lb/ft; Wall Mount SF: 4.4 lb/ft; Threaded-Rod T-Bar: 3.1 lb/ft; Threaded-Rod SF: 2.9 lb/ft

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

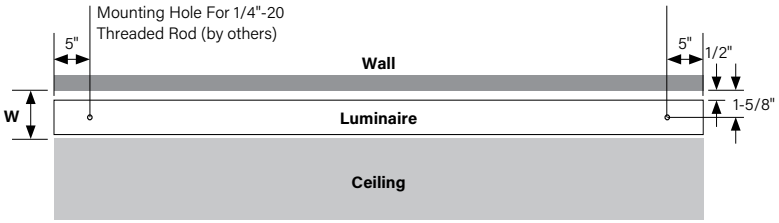
[1] Minimum 3' body section length when using standard Finelite Osram drivers.
Minimum 4' body section length when using other drivers
[2] 20 business days lead time for color

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

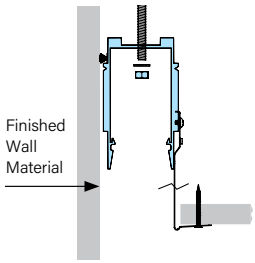
High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

THREADED-ROD (TR) MOUNTING LOCATION

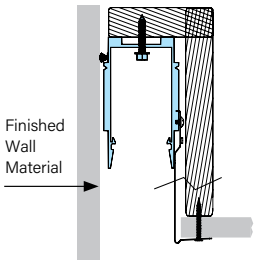


W (Rough-In): Spackle Flange & T-Bar: 3-1/8"

MOUNTING OPTIONS

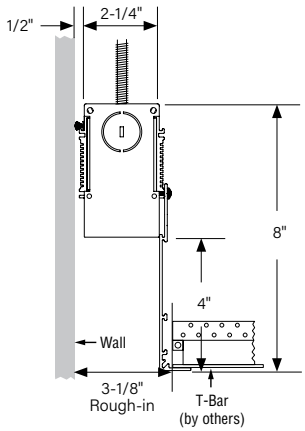


1/4"-20 Threaded Rod
(by others)

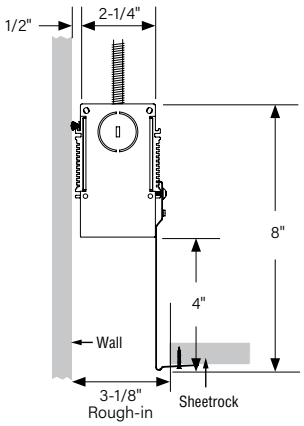


Screw Mount Option
(by others)

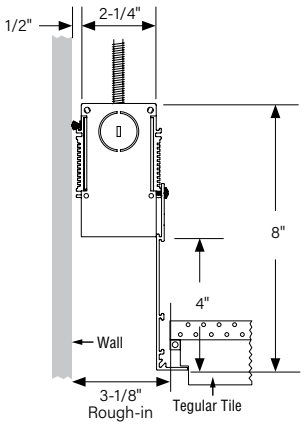
THREADED-ROD (TR) MOUNTING CROSS SECTIONS



(C1, C2, C3)



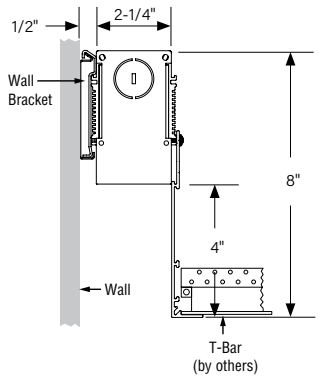
(SF)



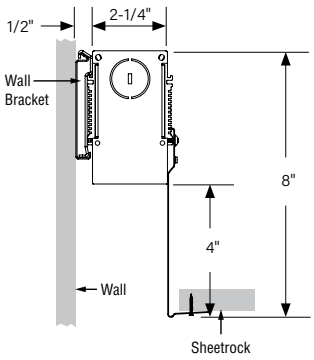
(C1T, C2T)

Note: Use blocking to allow room for finished wall materials such as stone, tile etc.

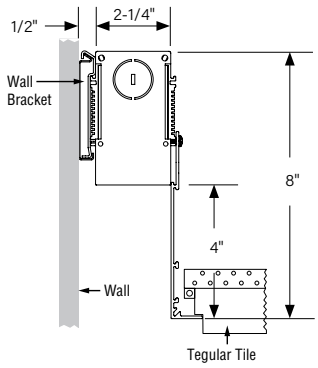
WALL BRACKET (WB) MOUNTING CROSS SECTIONS



(C1, C2, C3)



(SF)



(C1T, C2T)

Note: Use blocking to allow room for finished wall materials such as stone, tile etc.

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

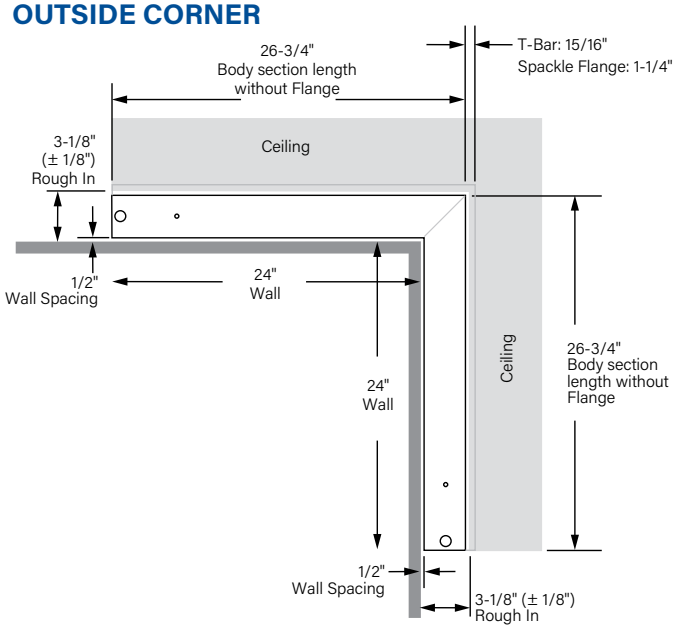
FINELITE® Better Lighting

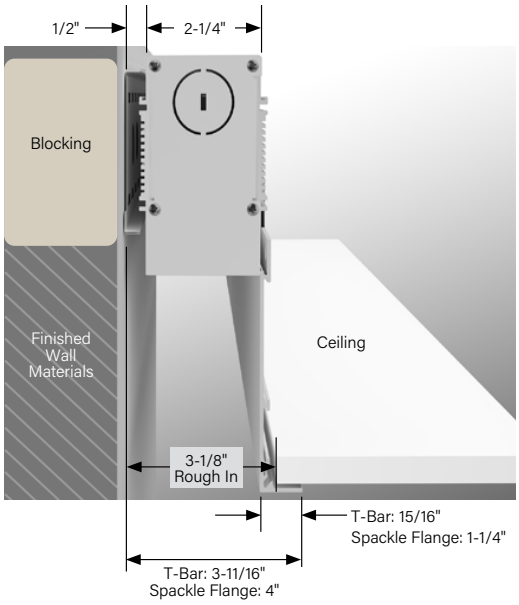
High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

PRE-BUILT 90º INSIDE AND OUTSIDE FULLY ILLUMINATED CORNERS

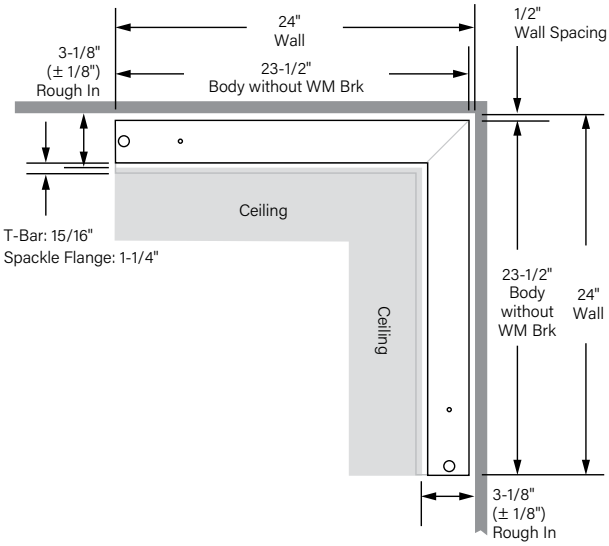
Pre-built inside and outside 90º corners provide fully illuminated corners. Mitered joints are pre-assembled in the factory for easy installation in the field. As shown in the example below, inside and outside corners take up 2ft of wall length to simplify the calculation of remaining run length.

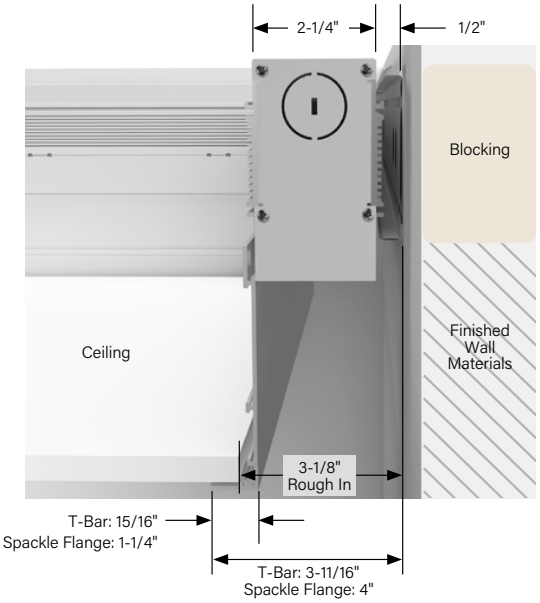
OUTSIDE CORNER





INSIDE CORNER





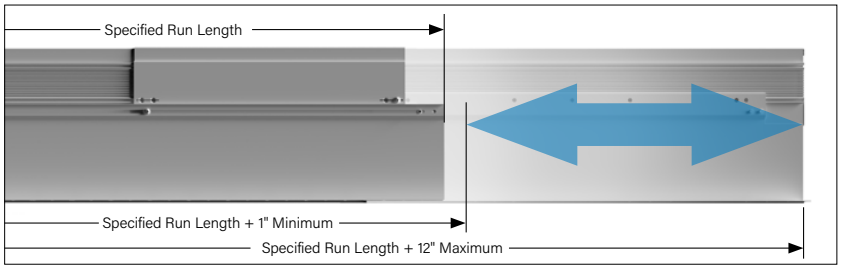
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

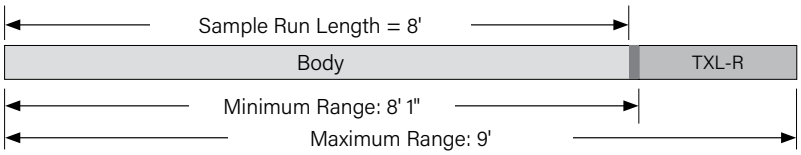
High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

TELESCOPING

One telescoping (**TXL**) provides on-site flexibility with up to 11" of adjustability. and can be specified on either end of a run. Telescope adds a minimum of 1" and maximum of 12" to the run length provided. Max single section length with TXL adjustable from 11'-1" to 12'-0". Offered with flat endcap (standard) or pocketslot endcap.

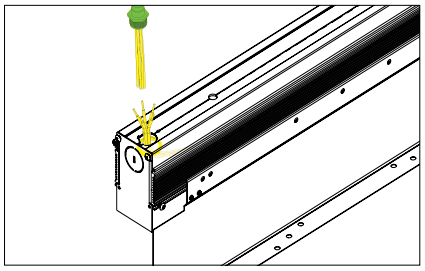


SF WM Telescoping Shown

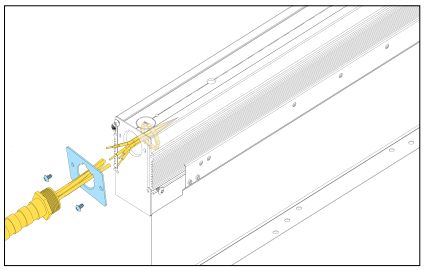


Ordering Sample: HP-2 WS-4D-8'-B-835-96LG-277-SC-FC-10%-WB-C1-FE-L-TXL-R-SW

POWER FEED



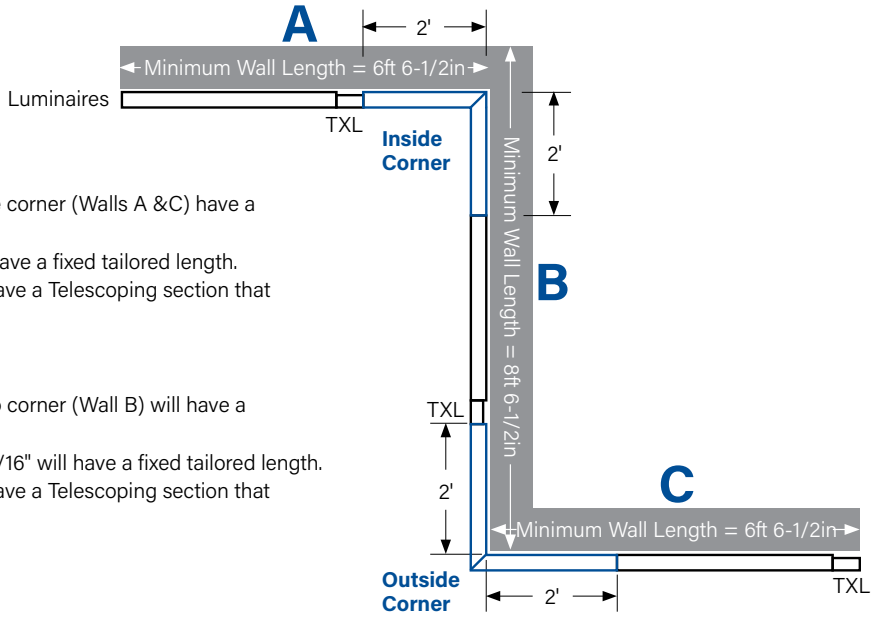
Top feed is standard. Top feed not available on a section with telescoping



End feed options

CONFIGURATIONS WITH PRE-BUILT CORNERS AND TELESCOPING

The example below demonstrates the target minimum wall length requirements for a configuration with pre-built 90 degree corners and telescoping. Consult factory for applications that require shorter than minimum lengths than shown below.



For configurations, wall segments with **One** corner (Walls A &C) have a minimum wall length of 4'.
- Wall lenghts between 4' to 6' 6-7/16" will have a fixed tailored length.
- Wall lengths of 6' 6-1/2" and greater will have a Telescoping section that provides +/- 5-1/2" of adjustability

For configurations, wall segments with **Two** corner (Wall B) will have a minimum wall length of 6'.
- Wall lengths between between 6' to 8' 6-7/16" will have a fixed tailored length.
- Wall lengths of 8' 6-1/2" and greater will have a Telescoping section that provides +/- 5-1/2" of adjustability

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Type:	Project:	
Ordering Info:		

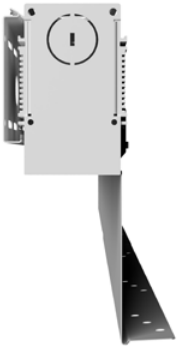
FINELITE® Better Lighting

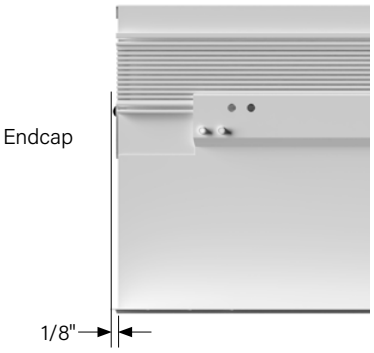
High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

ENDCAP OPTIONS

Endcap Information
The **Flat Endcap** adds 1/8" per endcap to the section length.
The **Pocket Slot Endcap** adds 1-1/4" for Spackle Flange and 1" for T-Bar per endcap to the section length.
Example: Overall Luminaire Length = Luminaire Section + Endcap + Endcap
11' - 3-1/2" = 11' - 3-1/4" + 1/8" + 1/8"

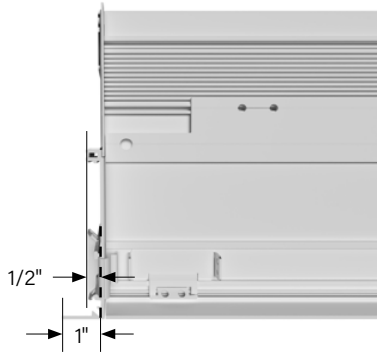
Standard Flat (FE-L or FE-R)
Add 1/8" per endcap to the section length. Spackle Flange version shown T-Bar available. Flat end condition for when luminaire terminates at a vertical surface such as a finished wall.



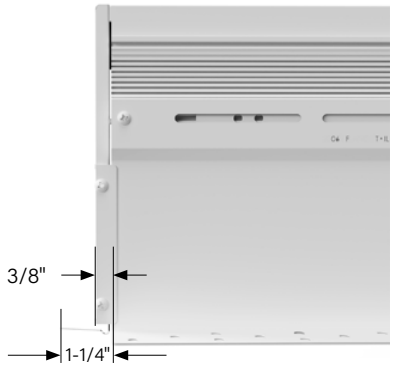


Pocket Slot (PE-L or PE-R)
Adds 1-1/4" for Spackle Flange and 1" for T-Bar (includes endcap dimension 1/8") per endcap to the housing length on shop drawings T-Bar version shown, Spackle Flange available.

T-Bar



Spackle Flange



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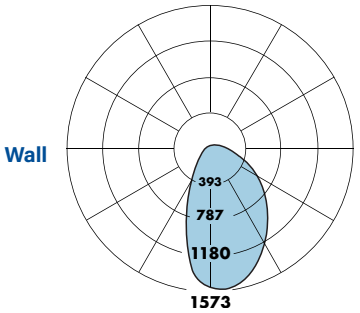
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2 WS)
Perimeter Slot

Recessed Photometry - 4' Luminaire 3500K

HP-2 WS-4D-4'-V-835
Efficacy: 90 lm/W
Total luminaire output: 3184 lumens (796 lm/ft)
35.4 watts (8.9 W/ft)
Peak Candela Value: 1552 @ 5º
CRI: 80 / CCT: 3500K
ITL LM79 Report 94264



CANDELA DISTRIBUTION

	0.0	22.5	45	67.5	90	Flux
0	1479	1479	1479	1479	1479	
5	1552	1527	1468	1418	1367	138
15	1547	1527	1396	1011	762	356
25	1407	1409	1255	530	190	458
35	1217	1226	1066	136	0	475
45	1027	1020	854	17	0	456
55	845	816	636	13	0	401
65	668	618	424	8	0	326
75	503	434	221	4	0	233
85	354	273	56	1	0	140
90	289	207	2	0	0	
95	265	181	0	0	0	87
105	198	120	0	0	0	58
115	135	71	0	0	0	34
125	81	34	0	0	0	17
135	39	9	0	0	0	6
145	8	0	0	0	0	1
155	0	0	0	0	0	0
165	0	0	0	0	0	0
175	0	0	0	0	0	0
180	0	0	0	0	0	

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B [1]**	**H [1]**	**V [2]**
1303	1639	2476	3184

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
326	410	619	796

Power, 3500K (Watts Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
3.5	4.4	6.8	8.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B [1]**	**H [1]**	**V [2]**
94	93	91	90

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 2476 lm x 0.789 = 1954 lm

Total Light Output per Foot: 619 lm/ft x 0.789 = 488 lm/ft.

watts/foot: 6.8 W/ft.

$$\textbf{Efficacy} = \frac{488\ \frac{\text{lm}}{\text{ft.}}}{6.8\ \frac{\text{W}}{\text{ft.}}} = 72\ \text{lm/W}$$

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

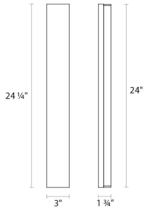
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 94264

SONNEMAN
A WAY OF LIGHT

Vanity LED Bath Bar Spec Sheet

SKU: 2543.01 Learn more at sonnemanlight.com
https://sonnemanlight.com/vanity-led-bath-bar

Size: Wide 24"
Color/Finish: Polished Chrome



Dimensions

Height:	3
Width:	24.25
Extends:	1.75
Minimum Extension:	1.75"
Maximum Extension:	1.75"

Electrical Specs

Bulb(s) Included?:	Yes
Bulb 1 Type:	Integral LED
Input Voltage:	120VAC
Wattage:	27
Initial Lumens:	1600
Delivered Lumens:	1450
Color Temperature:	3000K
CRI:	90
Power Supply Type:	Transformer
Power Supply Quantity:	1
Power Supply Location:	Outlet Box
Dimming Type:	ELV

Installation

Installation:	Licensed electrician required
Installation Orientation:	Any Orientation

General Listings

Features:	Damp Rated
Certification:	cETL

Available Finishes

Available Finishes: Polished Chrome

Shade

Shade 1 Material:	Optical Acrylic

Notes

LEDALITE by signify

Recessed

SilkSpace

2' x 2', 1' x 4', & 2' x 4'

SilkSpace combines LED Light Guide technology and Ledalite's revolutionary MesoOptics technology to deliver discrete, comfortable lighting with great performance and ultra low-glare.

Project:
Location:
Cat.No:
Type:
Line ID: Qty:
Notes:

Ordering guide – Standard

example: 4224D1STL8BAS7DE

Family	Size	Version	Configuration	Source	CRI/CCT[1]	Lumens[1]	Housing	Wiring[2]
42		D1		L				
42 SilkSpace	**22** 2'x2' **14** 1'x4'	**D1** Standard T-Grid	**ST** Standalone **CR** Continuous Row (1'x4' or 2'x4')	**L** LED	**8A** 80CRI/4000K **8B** 80CRI/3500K **8C** 80CRI/3000K	**D** 4000lm **E** 3000lm **K** 1700lm	**S** Standard **C** Chicago Plenum	**7** 1cct Dimming **N** 1cct Dimming + Battery Pack
	24 2'x4'					**A** 6800lm **C** 5200lm **D** 4000lm		

Voltage	Driver[2,3]	Option	Systems/Controls
D UNV 120-277V **3** 347V	**E** Advance 0-10V (1% Dim) **H** Lutron EcoSystem LDE1	**P** Flex Whip (6') **D** Drywall Trim Kit	
D UNV 120-277V	**S** Advance Sensor Ready (5% Dim)	**N** No Option **P** Flex Whip (6') **D** Drywall Trim Kit	**SZ** SpaceWise DT Daylight & Occupancy

1. Nominal values within a range. Consult photometry data for CRI, color temp, lumens & distribution of chosen configuration.
2. Not all wiring types are available with all configurations. Consult Ledalite for a complete list of available options.
3. Lutron EcoSystem Drivers are not available in 347V.

Standalone controls

SpaceWise DT

- Suspended version available with SpaceWise DT Daylight & Occupancy sensing with advanced grouping & dwell time.
- Dimming with compatible Zigbee wireless wall switches.

www.usa.lighting.philips.com/systems/lighting-systems/spacewise

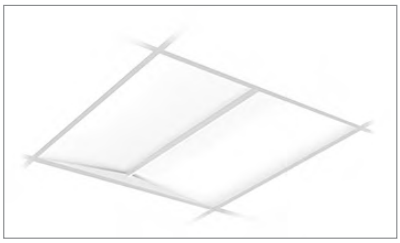
See p. 2 for Connected & IoT product offerings.

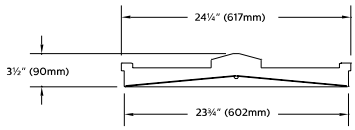
quickship · ETL · DLC · mesoOptics · interact ready.

SilkSpace recessed

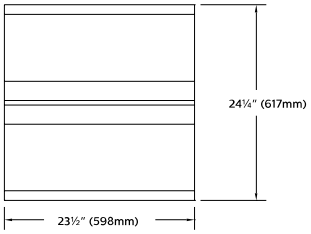
2'x2', 1'x4' & 2'x4'

2'x2'

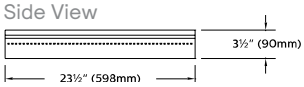




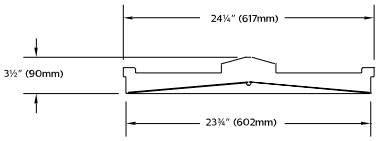
Lens View



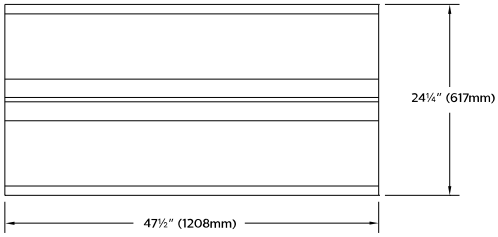
Side View



2'x4'

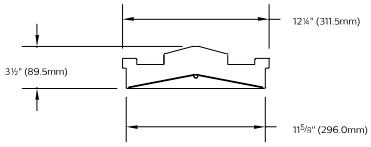


Lens View

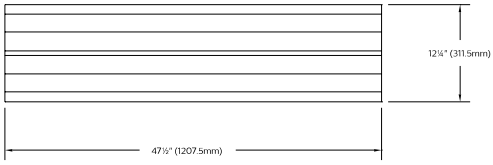


Side View

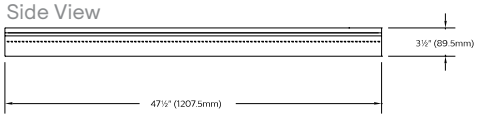
1'x4'



Lens View



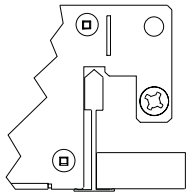
Side View



Mounting Details

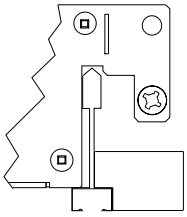
Flat T-Grid

Integrates with most common T-Grid ceiling types



Works with 9/16" & 15/16" flat T-Grid ceilings

Slot T-Grid



Can also be used with slot T-Grid ceilings. For 9/16" slot T-Grid ceilings, fixture will sit 5/16" above bottom of T-Bar.

SilkSpace recessed

2'x2', 1'x4' & 2'x4'

Specifications

Optical System

The optical system is comprised of arrays of LEDs edge lighting a low profile light guide panel. The micro structured surface of the light guide panel optimizes the light extraction creating a homogeneously luminous appearance. Light is then controlled by MesoOptics film suppressing the high-angle light creating an ultra low-glare bat-wing distribution.

Finish

Housing and Frame painted, high quality,
powder coated matte white only.

Housing

Sides and center spine: precision aluminum extrusion; end caps, back housing and driver cover: die-formed, 20 gauge cold-rolled steel, pre and post painted. Available in white. Multiple wire entrances are available (top or side) to allow continuous row mounting of fixtures.

Weight

Maximum 28lbs (2x4); 21lbs (1x4); 15lbs (2x2).

Electrical

Factory pre-wired with driver safety disconnect.

Mounting

Fixtures are factory pre-wired and tested for all circuits and emergency battery packs. Compatible with 15/16" lay-in acoustical ceilings using exposed grid suspension (NEMA type G). For 9/16" slot T-grid ceilings, fixture will sit 5/16" above bottom of Tee. Optional drywall kit trim mount can be fastened to a wood frame or with hangar wire. Continuous row mounting not available with drywall kit trim mounts.

Standard Driver

Advance Xitanium 0-10V, 1% dimming.

Advance Xitanium Sensor Ready (SR), 5% dimming.

PoE Lighting Controller (for PoE tunable white).

Lutron EcoSystem LDE1, 1% dimming with Soft-on, Fade-to-Black.

Class 2 rated output.
Consult Ledalite for other available drivers.

Standard Battery Packs

Bodine Battery Pack, 90 min, 10W, Class 2 rated output.
Lumen output = 10W x luminaire efficacy x 1.1. Typical output 1100lm.

PoE Battery Pack, 90 min, 6W, Class2 rated output.
Lumen output = 6W x luminaire efficacy. Typical output 650lm.

Lumen Maintenance

LEDs have been tested by the manufacturer in accordance with IESNA LM-80-08. At an ambient temperature of 25°C, the LED lumen maintenance expectation according to IES TM-21-11:
L90 (10k) >60,000 hrs (Reported methodology)
L80 (10k) 125,000 hrs (Projected methodology)

Source Color

LEDs rated for color rendering of:
CRI >80 & R9 >0
CRI >90 & R9>50

Fixture to fixture color accuracy within:
2 SDCM for Static White luminaires
3 SDCM for Tunable White luminaires

Wiring

Optional flex whips are supplied in 6' lengths.

Approvals

Certified to UL, CSA, and IES standards. City of Chicago Approved CCEA (housing option C). Certain versions without battery packs are DesignLights Consortium® qualified. Please see the DLC QPL list for exact catalog numbers www.designlights.org/QPL.

Quick Ship

Available for most non-connected configurations upon request. More information available at: www.signify.com/en-us/brands/ledalite/quickship

Warranty

Five-year luminaire limited warranty including LED boards and driver.
www.signify.com/warranties

Environment

Rated for dry & damp locations in operating ambient temperatures of 0-25°C (32-77°F). Many luminaire components, such as reflectors, refractors, lenses, and LEDs are made from various types of plastics which can be adversely affected by airborne contaminants. If sulfur based chemicals, petroleum based products, cleaning solutions, or other contaminants are expected in the intended area of use, consult factory for compatibility. Damage caused by sulfur, chlorine, petroleum based solution or other contaminants are not covered under warranty.

SilkSpace recessed

2'x2', 1'x4' & 2'x4'

Photometrics

2'x2'

Spacing Criteria: 1.37/1.65

(Click "PDF" and "IES" text to Download)

Lumen Package	Nominal CRI & CCT	Flux (lm)	Watts (W)	Efficacy (LPW)	CRI	DLC*	UGR	Photometry Report	IES File
4000lm	80CRI, 4000K	4037	39.3	102.7	82	Standard	19	PDF	IES
	80CRI, 3500K	3972	39.3	101.1	82	Standard	19	PDF	IES
	80CRI, 3000K	3905	39.4	99.1	81	Standard	19	PDF	IES
3000lm	80CRI, 4000K	2978	27.8	107.1	82	Standard	18	PDF	IES
	80CRI, 3500K	2931	27.8	105.4	82	Standard	18	PDF	IES
	80CRI, 3000K	2876	27.9	103.1	81	Standard	18	PDF	IES
1700lm	80CRI, 4000K	1832	16.6	110.4	82	N/A	16	PDF	IES
	80CRI, 3500K	1810	16.7	108.4	82	N/A	16	PDF	IES
	80CRI, 3000K	1768	16.7	105.9	81	N/A	16	PDF	IES

*Configurations with Battery Pack options are not DLC eligible.

CANDELA DISTRIBUTION

	0	22.5	45	67.5	90	Flux Lumens
0	1052	1052	1052	1052	1052	
5	1052	1052	1053	1055	1057	101
15	1041	1048	1066	1086	1094	303
25	1011	1033	1090	1151	1174	505
35	933	972	1073	1181	1217	665
45	669	704	797	913	956	616
55	362	376	416	467	507	387
65	205	210	223	239	247	225
75	86	88	96	104	108	104
85	17	18	21	24	26	24
90	0	0	0	0	0	
95	0	0	0	0	0	0
105	0	0	0	0	0	0
115	0	0	0	0	0	0
125	0	0	0	0	0	0
135	0	0	0	0	0	0
145	0	0	0	0	0	0
155	0	0	0	0	0	0
165	0	0	0	0	0	0
175	0	0	0	0	0	0
180	0	0	0	0	0	

*Photometric data shown is for 3000lm, 3500K, 80 CRI configuration.

COEFFICIENTS OF UTILIZATION (%)

Pc---	80				70			50			0
Pw---	70	50	30	10	70	50	30	50	30	10	0
RCR											
0	119	119	119	119	116	116	116	111	111	111	100
1	110	106	102	99	108	104	100	100	97	94	87
2	101	94	88	83	99	92	87	89	84	80	74
3	93	84	76	70	91	82	75	79	73	69	64
4	86	75	67	61	84	73	66	71	64	59	56
5	79	67	59	53	77	66	58	64	57	52	49
6	73	61	52	46	71	60	52	58	51	46	43
7	68	55	47	41	66	54	47	53	46	41	38
8	63	50	42	37	62	50	42	48	41	36	34
9	59	46	38	33	58	46	38	45	38	33	31
10	55	43	35	30	54	42	35	41	34	30	28

ZONAL LUMEN SUMMARY

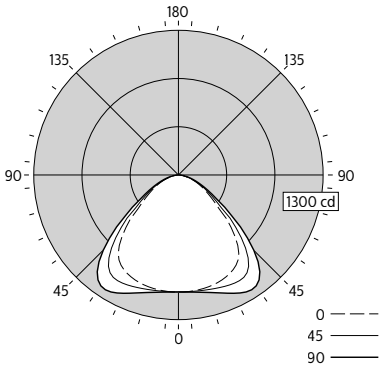
Zone	Lumens	%Fixture	%Lamp
0-30	909	31.0%	31.0%
0-40	1574	53.7%	53.7%
0-60	2578	88.0%	88.0%
0-90	2931	100.0%	100.0%
90-130	0	0.0%	0.0%
90-150	0	0.0%	0.0%
90-180	0	0.0%	0.0%
0-180	2931	100.0%	100.0%

Electrical

Voltage (V)	Power (W)	Current (A)	THD (%)	Power factor
120	27.8	0.233	8.3	0.994
277	27.7	0.105	12.2	0.950
347	N/A	N/A	N/A	N/A

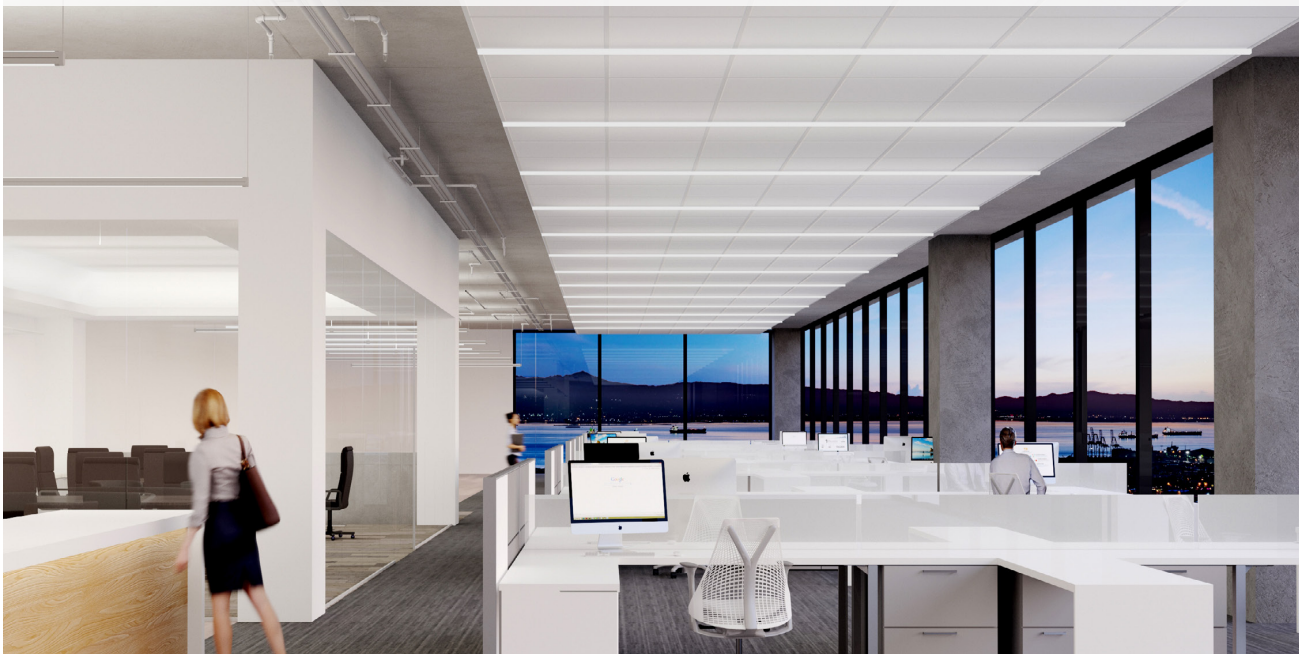
AVG LUMINANCE (cd/m²)

	0	45	90
0	3152	3152	3152
5	3164	3166	3180
15	3229	3306	3393
25	3341	3605	3880
35	3412	3925	4452
45	2833	3378	4052
55	1890	2173	2651
65	1455	1582	1749
75	991	1108	1255
85	571	705	887



0% Up / 100% Down

vode® Adaptive architectural lighting systems



Spec Guide

ZipTwo® | Round 3515 | 707

Direct lighting for open office and ambient applications.

Round 3515, Diffuse, white

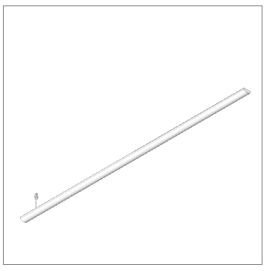
Benefits & Features

Low Profile Design
Round profile. 1.38" (35mm) x 0.60" (15mm).

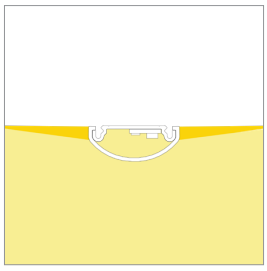
Superior Light Quality with High Diffusion
Output up to 1071 lm/ft (3512 lm/m) (HO), 110 lm/W (SO). 80 or 90 CRI & tunable white (2200K-5000K) available.

Versatile Mounting Options, Easy Installation
Magnet with tape-on metal strip or low profile clip allow for mounting to almost any surface or T-Bar ceiling.

High Diffusion & Uniform Distribution
Wide, soft distribution without diode image.



Single Rail



Light Distribution

Build Your Specification

707-Z2	SL				0

System & Rail Type
707-Z2 ZipTwo

System Type
SL Standard Linear

System Length
Specify overall system length in ft/in or M/mm.

Corner and Shapes Available ***See Guide*** *for details*

Rail Length
24 24" (610mm)
36 36" (914mm)
48 48" (1219mm)
60 60" (1524mm)
72 72" (1829mm)
96 96" (2438mm)
108 108" (2743mm)
120 120" (3048mm)
132 132" (3352mm)
144 144" (3658mm)
ZZ Other rail length or layout (please specify)

See ***Rail Length Chart*** *for more details*

Mounting
C Clip
CM Clip with Micro J-Box
T Magnet with Tape-On Metal Strip
T1 9/16" T-Bar Clip, low profile
T2 15/16" T-Bar Clip, low profile
T3 15/16" T-Bar Clip, medium profile
T4 15/16" T-Bar Clip, concealed
T5 9/16" T-Bar Clip, medium profile
T6 Slotted T-Bar Clip
T7 Dimensional T-Bar Clip
SC Strut Channel Clip
DM Armstrong DynaMax
ZZ Other (please specify)

Arm/Cord Length
0 None

				Z

Power Location
Remote Power
RP25 25' (7.62m) Wire Harness
RP50 50' (15.24m) Wire Harness
RP75 75' (22.86m) Wire Harness
RP100 100' (30.48m) Wire Harness

Power Type
Flexible 1 to 1 Power
AE eldoLED 0-10v, 1.0% Dimming
AT eldoLED 0-10v, 0.1% Dimming
AD eldoLED DALI, 0.1% Dimming
AX eldoLED DMX, 100-0% Dimming
AH Hi-lume 1% EcoSystem, Soft On / Fade to Black Technology, LDE1
AH2 Hi-lume 1% 2-wire LTEA2W (120V forward phase only)

Optomized Power
AEO eldoLED 0-10v, 1.0% Dimming
ATO eldoLED 0-10v, 0.1% Dimming
ADO eldoLED DALI, 0.1% Dimming
AXO eldoLED DMX,100-0% dimming

ZZ Other (please specify)

See* ***Power Guide* *for driver features & limitations.*

Voltage
1 120v
2 120v-277v
X Not Yet Specified

Emergency Power
0 No Emergency Power
ZZ Emergency Power *(specify requirements)*

LED Type
Z Zipper Board™

		S4	

Lumen Output
LO Low Output
SO Standard Output
HO High Output*
ZZ Other (please specify)

See ***IES Files*** *page for details.*
See* ***Power Guide* *for driver features & limitations.*

Color Temperature
80+ CRI
27 2700K
30 3000K
35 3500K
40 4000K

90+ CRI
279 2700K
309 3000K
359 3500K
409 4000K

ZZ Tunable White Available ***See Guide*** for details

Optics
S4 Round 3515, Diffuse (WH)

Sensors
0 None
ZZ Other (please specify)[1]

WH	

Finish
WH White

Options
0 None
9 9' 18/3 Cord and Plug
CP Contact factory for Chicago Plenum

NOTES & LIMITATIONS
[1] *Sensors are available please contact* ***Vode*** *for more information.*

5 Year Limited Warranty. See full Vode warranty description ***here*** *or at vode.com.*

Listed to UL standards for damp location by a Nationally Recognized Testing Laboratory (NRTL) recognized by OSHA.

Structure

Rail Lengths	*24" (610mm) - 144" (3658mm) See **Rail Length Chart** for more details.*
Rail Dimensions	1.38" (35mm) x 0.60" (15mm). See dimensions section for details.
Construction	Extruded and machined 6063 aluminum.
Mounting	Clip, Clip with Micro J-Box, Magnet with Tape-On Metal Strip, T-Bar Clips for most grid/panel construction, Strut Channel Clip.
Run Length	24" (610mm) minimum. Rail lengths may be installed end-to-end to any length.
Operating Temperature	32°F to 104°F (0°C to 40°C).
Humidity	0-95%, non-condensing. Suitable for damp locations.
System Weight	0.25lbs per ft (0.11kg per 305mm). *Power supply and housing not included.*

Materials

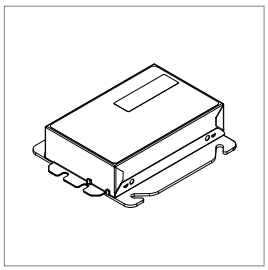
LED Board Construction	Aluminum core PCB, black LCP connectors, RoHS compliant.
Lens	High-impact extruded acrylic glass (PMMA).
Power Cable	Ø3mm, 33/2 AWG, Plenum (CMP) rated semi-rigid PVC or FEP, flame tested UL-910 *(PVC free in 2020)*
Cable Connectors	Unfilled black nylon, rated UL 94 V-0, halogen free, PVC or FEP overmold, RoHS compliant *(PVC free in 2020)*
Remote Linear Power Housing (RLP)	20.7" x 2.375" x 2.53", 0.054" formed Galvanized Steel
Remote Brick Power Housing (RBP)	4.32" x 3.37" x .078" Galvanized Steel mounting plate

Power and Controls

Power Type	Class 2 (<60v output) constant current driver
Dimming Controls	Dimming (0.1%, 1%), 0-10v, DALI, DMX, Lutron Hi-lume 1% are available. *See **Power Guide** for details.*
Input Voltage	120v - 277v, 50/60hz
Power Location	Remote power. Maximum remote distance up to 100' (30.5m) *depending* on driver selection. *See **Power Guide** for details.*

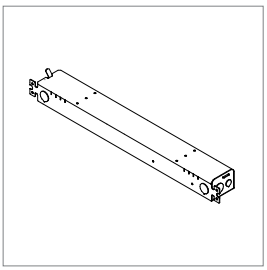
Remote power is locating the power supply away from the fixture. Remote power comes in two housing styles: brick style and linear style. Consult ***Power Guide*** to determine which type you will receive.

Remote Brick Power Housing



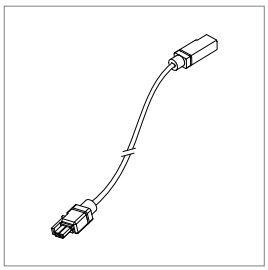
Supplied for some remote power applications. One remote power supply housing is supplied for each rail. Provided driver mounting plate fits standard 4" metal, square J-Boxes with a minimum volume of 21 in^3 (J-Box not provided).
See ***Tech Sheet*** for details.

Remote Linear Power Housing



One remote power supply housing is supplied with each power supply. All Vode linear remote drivers come in a 0.054" (0.8mm) formed galvanized steel power supply housing with five (5) knockouts: (4) 1-1/8", (1) 7/8" and (1) 9/16". Accommodates standard linear power supplies.
See ***Tech Sheet*** for details.

Wire Harness

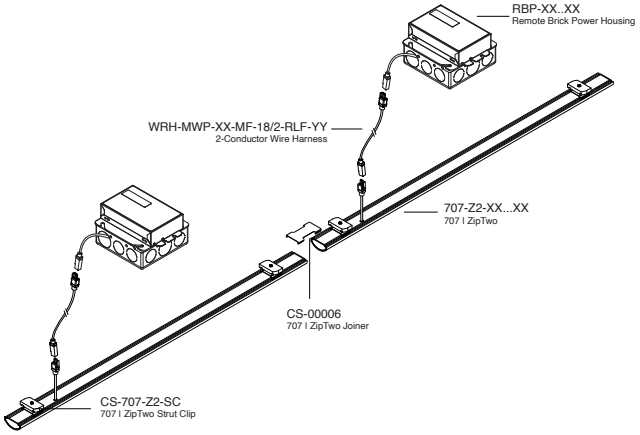


Wire harness connects driver to rail. Wire hareness is 25' (7.6m) with micro fit molex connectors for quick and easy installation. Multiple harnesses can be combined for a total length of up to 100' (30.5m).
See ***Tech Sheet*** for details.

Power and Controls

Flexible 1 to 1 power

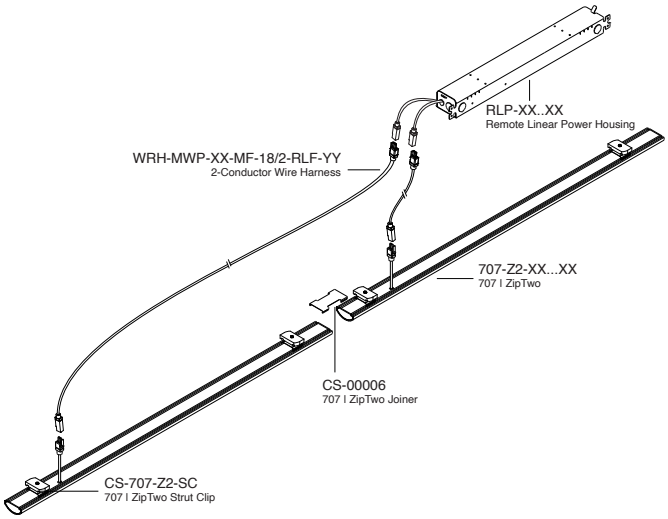
For Flexible 1 to 1 Power, Vode supplies one single output driver per fixture, allowing each fixture to be controlled independently. Direct/Indirect fixtures are supplied with two single output drivers, allowing the direct and indirect lighting to be controlled independently. Consult ***Power Guide*** to determine which type you will receive.



Optimized Power

To optimize power, Vode configures specifications with drivers that have 2 or 4 outputs. Depending on system configurations and power requirements, up to 4 fixtures can be powered from a 4-output driver. Consult ***Power Guide*** to determine which type you will receive.

IMPORTANT: Each fixture will still require individual wire harnesses, as shown below.

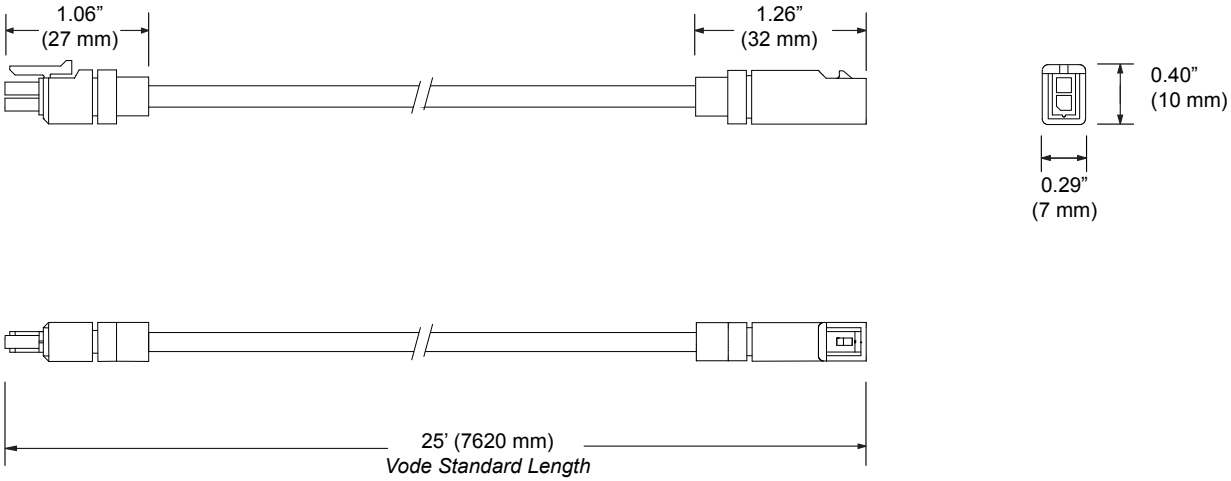


Note: Drawings not to scale, for reference only.

Power and Controls

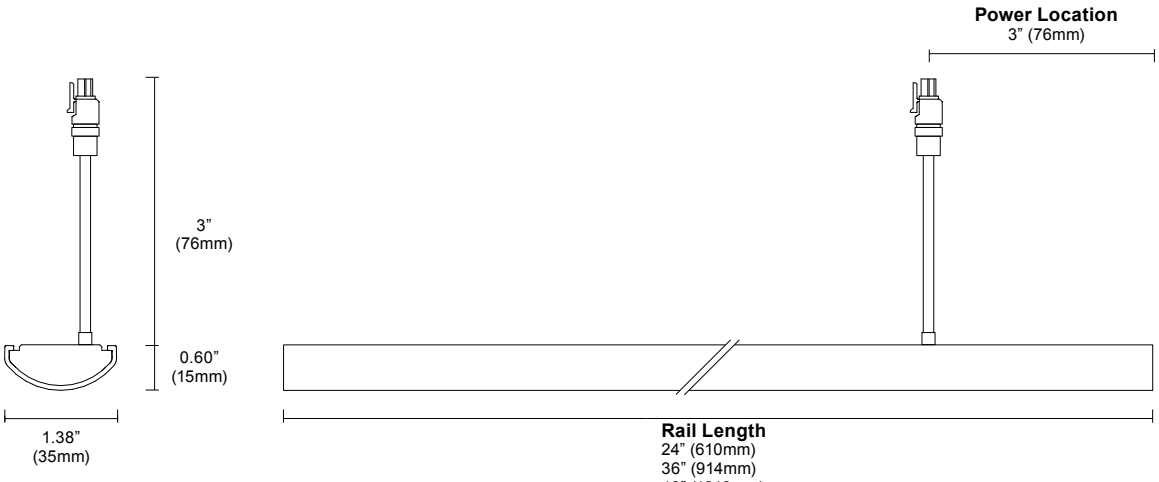
Wire Harness

Low voltage wire harness connects driver to rail. Wire hareness is 25' (7.6m) 18/2 AWG stranded wire with provided micro fit molex connectors on either end for quick and easy installation. Multiple haresses can be combined for a total length of up to 100' (30.5m). Refer to Vode Power Guide for max remote distance based on power selection. Consult ***Power Guide*** to determine which type you will receive.



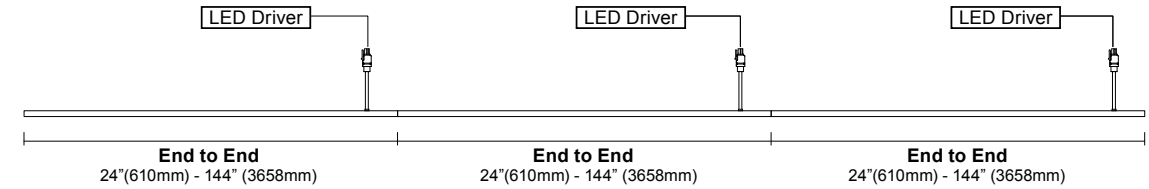
Note: Drawings not to scale, for reference only.

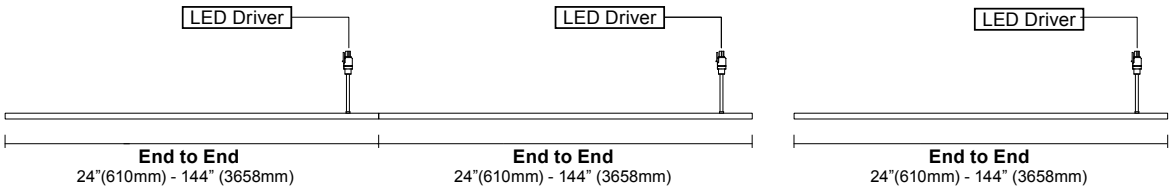
Dimensions



Rail Length
24" (610mm)
36" (914mm)
48" (1219mm)
60" (1524mm)
72" (1829mm)
96" (2438mm)
108" (2743mm)
120" (3048mm)
132" (3352mm)
144" (3658mm)

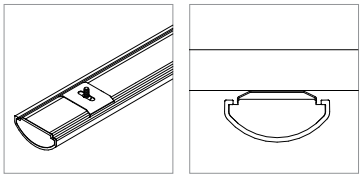
Layout

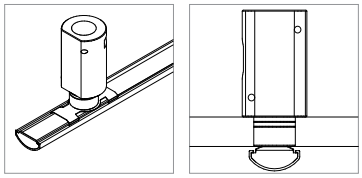


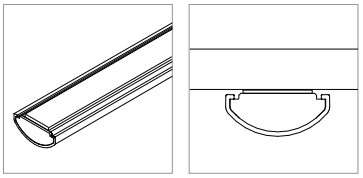


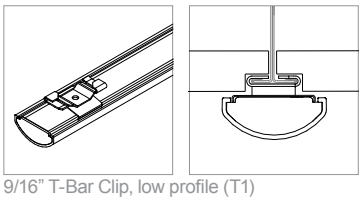
Corner and Shapes Available (Square, Rectangle, L-Shape, U-Shape, ZigZag)
See Guide for details

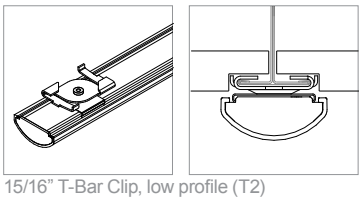
Mounting Options

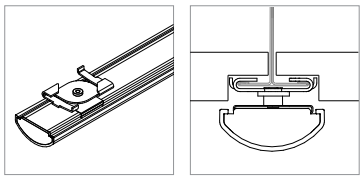

Clip (C)

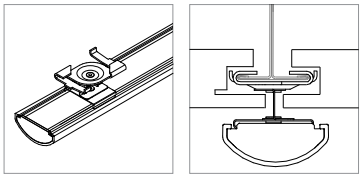

Clip with Micro J-Box (CM)

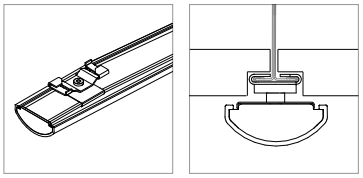

Magnet with Tape-On Ferrous Strip (T)

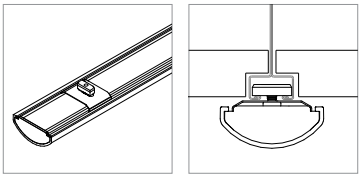

9/16" T-Bar Clip, low profile (T1)

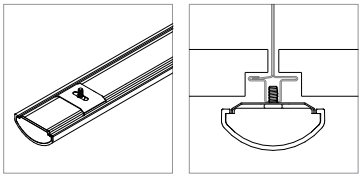

15/16" T-Bar Clip, low profile (T2)

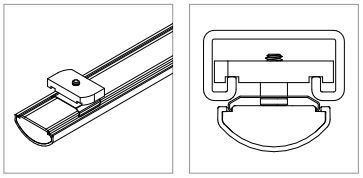

15/16" T-Bar Clip, medium profile (T3)

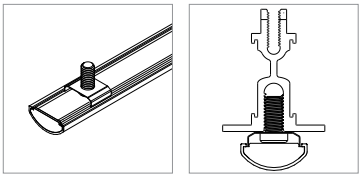

15/16" T-Bar Clip, concealed (T4)


9/16" T-Bar Clip, medium profile (T5)


Slotted T-Bar Clip (T6)


Dimensional T-Bar Clip (T7)


Strut Channel Clip (SC)

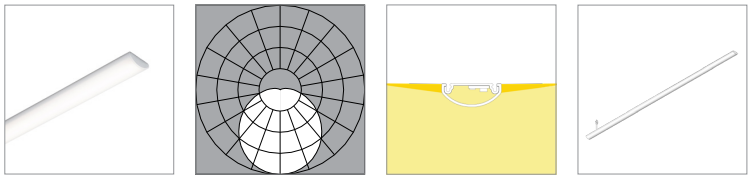

Armstrong DynaMax (DM)

See ***ZipTwo Clip Guide*** to check compatibility.

Performance | Zipper LED

Zipper Board has 72 diodes per foot (305mm). Testing based on a 4' rail section. Lumen measurement complies with IES-LM-79-08 testing procedures.

Round 3515, Diffuse (S4)



L80 is >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	109	112	114	114	94	97	99	100
Lumens per foot (305mm)	403	416	424	424	347	358	366	369
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	124	128	130	130	106	110	113	113
Lumens per foot (305mm)	806	831	848	848	695	717	731	739
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	123	127	129	129	106	109	111	113
Lumens per foot (305mm)	1209	1247	1273	1273	1042	1075	1097	1108
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

LOCATION		DATE	
PREPARED BY		QUANTITY	
COMMENTS		FIXTURE TYPE	
CATALOG NUMBER			

Nolan LED Sconce
NLS Series

Features
Metal accents with a clear outer glass and white acrylic inner diffuser.
Ideal use in hallways, entrances or anywhere general lighting is needed.
Provides lighting in residential, commercial and hospitality applications.
Meets ADA requirements. Fixture mounts standard to junction box (not included).

Construction
A 22-gauge shallow metal pan is made by stamping process and plated.
The front plate is 20-gauge steel with decorative metal trim plated.
The shade in shade design with clear outer acrylic and white inner diffuser.
Fixture has an open top with white acrylic diffuser on bottom.
Power supply connections must be made inside a junction box (not included).

Finish
Satin Nickel or Oakley Bronze with clear lacquer finish.

Diffuser
White acrylic interior diffuser is .100" thick. Exterior clear acrylic diffuser is .100" thick. Distance between both diffusers and diffuser assembly is held by a plastic spacer at the bottom of the diffuser.

Electrical
Input 120-277 VAC 60 Hz. 0.14A at 120 VAC.
Compatible with residential (TRIAC/ELV) and commercial (0-10V) dimmers.
TRIAC and ELV dimming only at 120 VAC.

LED
Integrated LED modules capable of producing:
17W = 1400 source lumens
Adjustable Choice 3000K, 3500K, 4000K (CCT).
Rated for 50,000 Hrs. 90 CRI.

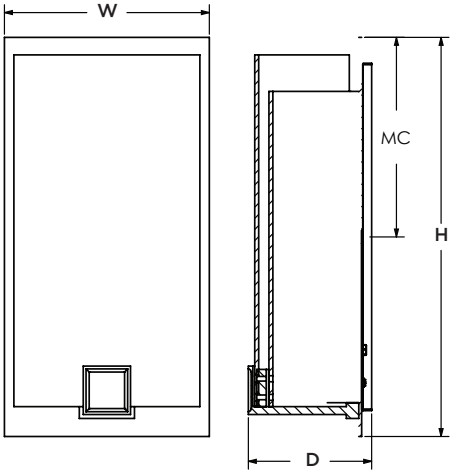
Certification
All fixtures are cETLus listed for indoor damp locations.
ADA

Warranty
Limited warranty: This fixture is free from defects in materials and workmanship for a period of 5 years from date-of-purchase.

Specifications and dimensions subject to change without notice.

Satin Nickel

Oakley Bronze



MC - Mounting Center

Ordering Information:

Satin Nickel	Oakley Bronze	LED	Source Lumens	Adjustable CCT	H	W	D	MC
NLS061214LAJUDSN	NLS061214LAJUDKB	17W	1400	3000K/3500K/4000K	12-5/8"	6-1/2"	3-7/8"	6-1/2"

Lighting Services Inc **IMAGE PROJECTOR SERIES**

Job Name Here	Fixture Type Here
Designer/Firm Name Here	Ordering Information Here

BPM • 120/277V • LED

The miniature BPM series is a professional grade high output LED instrument with features such as 360 degree gate rotation, true "E" size gobo projection, 3 plane cool touch shutters and easily changed zoom lenses (narrow and wide).

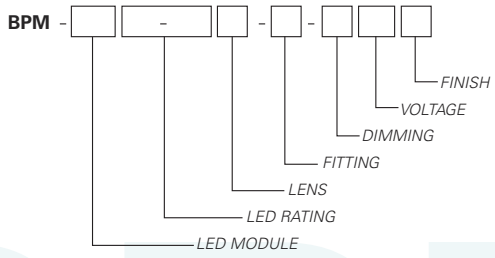
- 36,300 hour life to 70% lumen output, L70 at 95° max ambient
- Ideal for medium throw applications up to 20 feet
- Accepts industry standard, size "E" Gobo or custom projection patterns
- Fully rotatable lens barrel for easy image alignment
- Can be configured for use on 120, 230, or 277V systems
- Four cool-touch framing shutters on 3 planes for creating unlimited variations of geometric shapes, including true triangles
- Vertical and horizontal tool-less locking
- On/off safety switch (on most mounting types)
- Lexan track fitting with integral electronic driver compatible with reverse phase (ELV compatible) dimmers down to 5%
- Integral drop-in accessory cartridge accepts dichroic color filters and accessories (Industry size E; LSI size BPM)
- Locking zoom lens produces smooth, continuous change of beam size (Choose narrow beam or wide beam lens) 20° through 60°
- Spring loaded front accessory holder for gel media
- Finishes: LSI Black, White, and Silver
- Fixture weight: 3.5 lbs.

FIXTURE PART NUMBERS

Please review the **ORDERING INFORMATION** section on the next page as well as the **MOUNTING OPTIONS** on page 3 to create a part number for each fixture that specifies the following:

- LED Module
- LED Rating
- Lens
- Fitting/Controls (Dimming)
- Voltage
- Finish

PART NUMBER

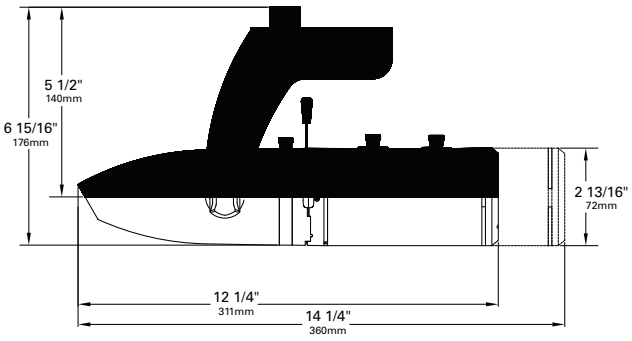


Example Part Number: **BPM-C0615-9030W-00-TE120W** is a fixture with a COB LED module, 1500 Lumen/90 CRI/ 3000°K Color Temperature/19 Watt LED rating, Wide Angle Lens Assembly, 00 Track fitting with Trailing Edge group dimming capability, 120V and a Black finish.

Lighting Services Inc **IMAGE PROJECTOR SERIES**

Job Name Here	Fixture Type Here
Designer/Firm Name Here	Ordering Information Here

BPM • 120/277V • LED



ACCESSORIES

Other accessories:

- **Glass Dichroic Color Filters BPM**
- **Color and Spread Gels BPMFR**

LENS SYSTEMS

Narrow Beam Lens Assembly
BPMNL range: 20°-31° Length: 14-1/4" (overall length, fixture and lens) Specify finish.

Wide Beam Lens Assembly
BPMWL range: 36°-60° Length: 12-1/4" (overall length, fixture and lens) Specify finish.

ORDERING INFORMATION

Base Fixture Model

☐ BPM-C06 (COB 6mm)

LED Rating (Lumens/CRI/Color Temperature/Wattage)

☐ 15-9027 = 1500/90/2700K/19
☐ 15-9030 = 1500/90/3000K/19
☐ 16-9035 = 1600/90/3500K/19
☐ 17-8027 = 1725/80/2700K/19
☐ 17-9040 = 1725/90/4000K/19
☐ 18-8030 = 1856/80/3000K/19
☐ 18-8035 = 1856/80/3500K/19
☐ 20-8040 = 1988/80/4000K/19

Consult factory for other color temperatures

Choose the alpha code to designate the desired

Lens Assembly

☐ **(N)** for Narrow Angle (20°-31°)
☐ **(W)** for Wide Angle (36°-60°)
☐ **(Z)** for No Lens (BPM unit with no lens)

Select your **Fitting/Controls (Dimming)**

☐ 00-TE = Track Fitting & Trailing Edge (5%)
☐ 00-LE = Track Fitting & Leading Edge (5%)
☐ 0E-ED = Track Fitting with Integral Dimmer (10%)
☐ 2G-TE = Universal Fitting & Trailing Edge (5%)
☐ 2G-LE = Universal Fitting & Leading Edge (5%)
☐ 3G-TE = Pipe Clamp Fitting & Trailing Edge (5%)
☐ 3G-LE = Pipe Clamp Fitting & Leading Edge (5%)
☐ 5A-TE = Canopy Fitting & Trailing Edge (5%)
☐ 5A-LE = Canopy Fitting & Leading Edge (5%)
☐ 5A-ED = Canopy Fitting & Integral Dimmer (10%)
☐ 5A-10 = Canopy Fitting & 0-15V (5%)

- Coiled Cord is available only with **2G** and **3G** mounting options. Change 2G to **2C** and 3G to **3C**. (When a coiled cord is not specified, a straight cord is provided.)

Voltage

☐ 120 = 120V ☐ 230 = 220-240V ☐ 277 = 277V

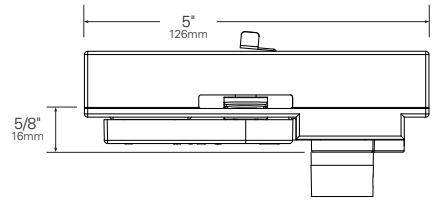
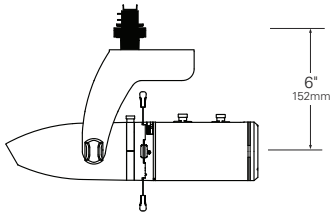
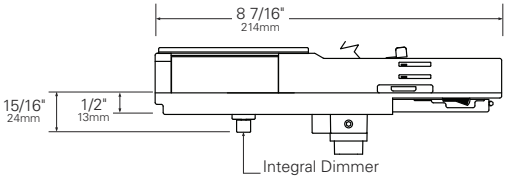
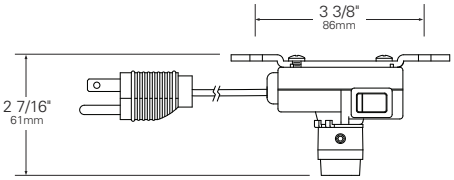
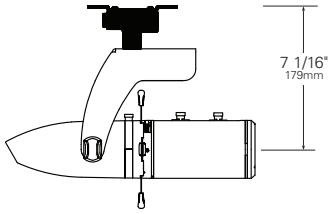
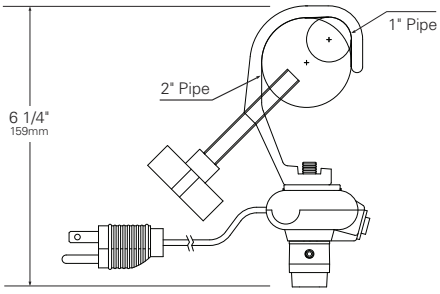
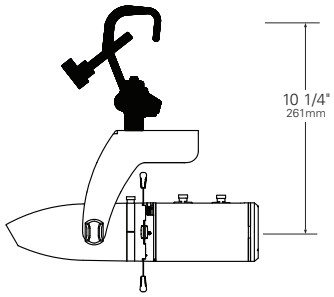
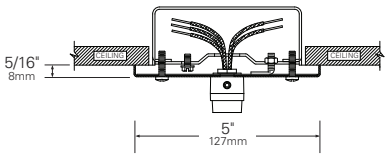
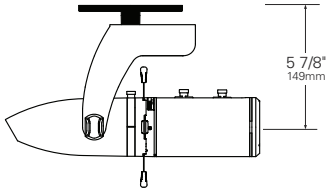
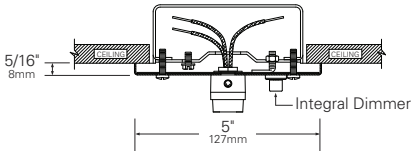
Finish

☐ B = Black ☐ W = White ☐ S = Silver

BPM	- C06	15-9030	W	- 00-TE	120	B
FIXTURE	LED MODULE	LED RATING	LENS	FITTING/DIMMING	VOLTAGE	FINISH

Lighting Services Inc **IMAGE PROJECTOR SERIES**

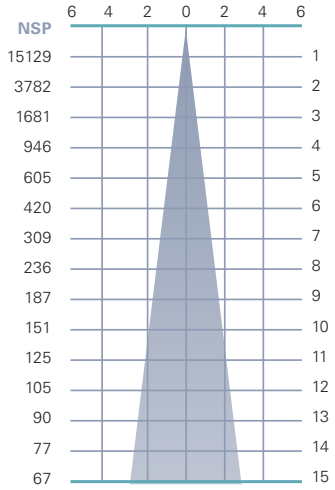
BPM • MOUNTING OPTIONS

FITTING	SIDE VIEW	PROFILE VIEW
00 Track Fitting/ EF Security/Worklight Fitting		
0E-ED Track Fitting with Integral Dimmer		
2G Universal Fitting		
3G Pipe Clamp Fitting		
5A Canopy Fitting with TE, LE, DX and 0-10V Dimming		
5A-ED Canopy Fitting with Integral Dimmer		

BPM • PHOTOMETRIC DATA

All Max. Footcandles at 0° Beam Axis

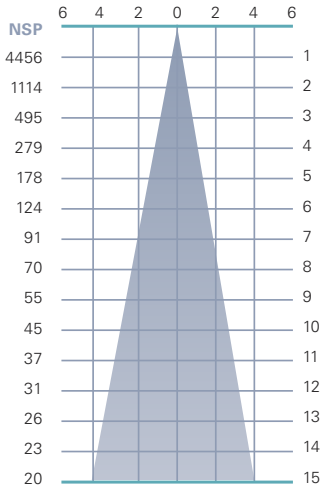
All Distances in Feet



BPM (18-8030) - Narrow/Lens

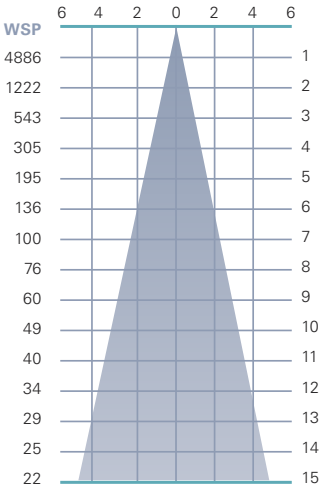
Beam spread (Minimum)	**20°**
Center beam candlepower	**15129**

All Distances in Feet



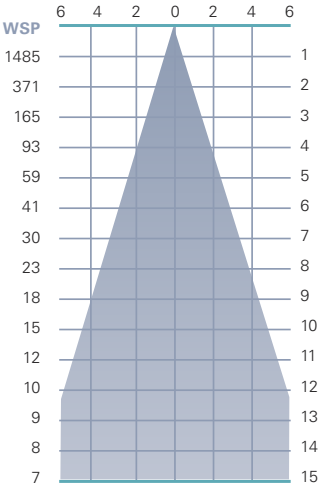
BPM (18-8030) - Narrow/Lens

Beam spread (Maximum)	**31°**
Center beam candlepower	**4456**



BPM (18-8030) Wide Lens

Beam spread (Minimum)	**36°**
Center beam candlepower	**4886**



BPM (18-8030) Wide Lens

Beam spread (Maximum)	**60°**
Center beam candlepower	**1485**

BPM • ACCESSORIES

LENS SYSTEMS

Narrow Beam Lens Assembly
BPMNL range: 20°-31°
Length: 14-1/4" (overall length, fixture and lens) Specify finish.

Wide Beam Lens Assembly
BPMWL range: 36°-60°
Length: 12-1/4" (overall length, fixture and lens) Specify finish.

For custom GOBOS, please contact:
ROSCO: www.rosco.com
GAM: www.gamonline.com
APOLLO: www.apollodesign.net/gobos
Size E Gobo (37.5mm OD x 28mm Image)

Lighting Services Inc **IMAGE PROJECTOR SERIES**

BPM • GELS

As the foremost innovator in accent lighting, LSI offers a complete range of pre-cut Gels to modify the spread and color of light.

BPM SPREAD GELS

Size: BPMFR	Spread Gel
GEL–L1–BPMFR	1° Spread Gel
GEL–L5–BPMFR	5° Spread Gel
GEL–L10–BPMFR	10° Spread Gel
GEL–L20–BPMFR	20° Spread Gel
GEL–L30–BPMFR	30° Spread Gel
GEL–L40–BPMFR	40° Spread Gel
GEL–L60–BPMFR	60° Spread Gel
GEL–L80–BPMFR	80° Spread Gel
GEL–L30B5–BPMFR	30° by 5° Spread Gel
GEL–L40B2–BPMFR	40° by 0.2° Spread Gel
GEL–L60B1–BPMFR	60° by 1° Spread Gel
GEL–L60B10–BPMFR	60° by 10° Spread Gel
GEL–L75B45–BPMFR	75° by 45° Spread Gel
GEL–L90B60–BPMFR	90° by 60° Spread Gel
GEL–R101–BPMFR	Beam Softener

BPM COLOR GELS

Size: BPMFR	Gel Color	% of Light Transmission	Size: BPMFR	Gel Color	% of Light Transmission
GEL–R2–BPMFR	Bastard Amber	78	GEL–R312–BPMFR	Canary	85
GEL–R7–BPMFR	Pale Yellow	96	GEL–R331–BPMFR	Shell Pink	68
GEL–R12–BPMFR	Straw	88	GEL–R383–BPMFR	Sapphire Blue	4
GEL–R13–BPMFR	Straw Tint	78	GEL–R397–BPMFR	Pale Grey	70
GEL–R14–BPMFR	Medium Straw	68	GEL–R2001–BPMFR	Storaro Red	12
GEL–R21–BPMFR	Golden Amber	43	GEL–R2004–BPMFR	Storaro Green	15
GEL–R25–BPMFR	Orange Red	14	GEL–R2009–BPMFR	Storaro Violet	3
GEL–R26–BPMFR	Light Red	12	GEL–R3202–BPMFR	Full Blue	36
GEL–R27–BPMFR	Medium Red	4	GEL–R3204–BPMFR	Half Blue	52
GEL–R57–BPMFR	Lavender	24	GEL–R3206–BPMFR	Third Blue	64
GEL–R62–BPMFR	Booster Blue	54	GEL–R3216–BPMFR	Eighth Blue (Boosts 3200K to 3300K)	81
GEL–R71–BPMFR	Sea Blue	30	GEL–R3318–BPMFR	Tough 1/8 Minusgreen	89
GEL–R72–BPMFR	Azure Blue	44	GEL–R3410–BPMFR	Roscosun (1/8 CTO) (Reduces 5500K to 4900K)	92
GEL–R91–BPMFR	Primary Green	7	GEL–R3441–BPMFR	Full Straw (CTS)	50
GEL–R97–BPMFR	Light Grey	50	GEL–R3443–BPMFR	Quarter Straw (CTS)	81
GEL–R98–BPMFR	Medium Grey	25	GEL–R4330–BPMFR	CalColor 30 Cyan	63
GEL–R101–BPMFR	Light Frost	N/A	GEL–R4415–BPMFR	CalColor 15 Green	67
GEL–R104–BPMFR	Tough Silk	N/A	GEL–R4490–BPMFR	CalColor 90 Green	25
GEL–R119–BPMFR	Lt. Hamburg Frost	N/A	GEL–R4860–BPMFR	CalColor 60 Pink	46
GEL–R121–BPMFR	Blue Diffusion	N/A	GEL–R4890–BPMFR	CalColor 90 Pink	38
GEL–R305–BPMFR	Rose Gold	75	GEL–R4930–BPMFR	CalColor 30 Lavender	47

LSI ROSCO GEL CCT CONVERSION CHART FROM 3000K

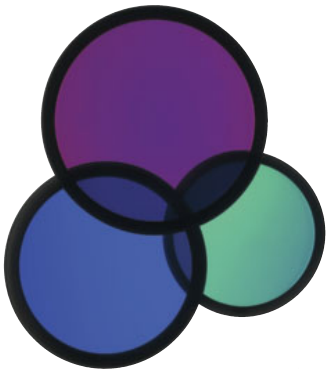
Type	ROSCO #	ROSCO Description	Resulting CCT
Amber Filters Lower CCT	3420	Double CTO	1531
	3407	Sun CTO	1999
	3401	Sun 85	2154
	3411	Sun 3/4 CTO	2154
	3408	Sun 1/2 CTO	2414
	3409	Sun 1/4 CTO	2664
	3410	Sun 1/8 CTO	2830
	3114	UV Filter	2930
Blue Filters Raise CCT	3220	Double Blue	N/A
	3202	Full Blue	4942
	3203	Three-Quarter Blue	4286
	3204	Half Blue	3769
	3206	Third Blue	3517
	3208	Quarter Blue	3297
	3216	Eighth Blue	3112

COLOR MEDIA

DICHROIC COLOR FILTERS

In addition to our complete line of glass color filters, LSI now offers dichroic glass color filters that achieve purer, more saturated, richer color by selective wavelength transmission. Since these filters reflect rather than absorb the unwanted color wavelengths, a higher intensity of colored light can be obtained with fewer or lower wattage fixtures. In addition, this selective transmission allows for very accurate color matching from filter to filter.

All standard LSI filter sizes are available in a wide palette of well chosen dichroic colors that can be used with all LSI fixtures that accept accessories.



Size	Diameter	LSI Fixture Series
BPM (Industry size E)	37.5mm (1 1/2")	BPM

Technical Data

Dichroic color filters are created in a vacuum chamber by multi-layer vapor deposits of different minerals onto low expansion, chemically resistant Borosilicate glass.

Deposits are made in alternating layers of varying microscopic thickness which allow very narrow color wavelengths to be selectively transmitted and all other wavelengths to be reflected.

LSI does not recommend using dichroic color filters with lamps or fixtures that have beam spreads greater than 40° because a secondary color aura is created by the wide angular transmitted wavelengths that are different than the desired color wavelength.

Since there is mainly transmission and reflection of the color wavelengths by the dichroic filter and very little absorption, the dichroic filter can be used with many high temperature lights that normally would not accept color filters.

No.	Color	% of Light Transmission
2001	Light Pink	69
2002	Medium Pink	43
2003	Hot Pink	11
2004	Pale Pink	55
2010	Deep Magenta	29
2011	Lavender	24
2012	Vivid Magenta	31
2013	Lavender Accent	48
2014	Lilac	37
2015	Purple Fusion	12
2020	Sky Blue	39
2021	Sea Blue	39
2022	Cyan	33
2023	Light Blue Green	30
2024	Primary Blue	24
2025	Medium Red Blue	15
2026	Deep Purple	16
2027	Peacock Blue	53
2028	Mediterranean Blue	20
2029	Boost Blue	51
2040	Light Yellow Green	64
2041	Fern Green	47
2042	Turquoise	35
2043	Primary Green	31
2044	Industrial Green	64
2050	Yellow	80
2051	Amber	71
2052	Amber Blush	38
2053	Bastard Amber	71
2054	Goldenrod	63
2055	Bright Straw	56
2060	Medium Orange	51
2061	Orange	44
2070	Flame Red	27
2071	Primary Red	25

Lighting Services Inc

SURFACE TRACK (120/250V) • SPECIFICATIONS

GENERAL Lighting Track shall allow fixtures to be located anywhere along the track length. Fixtures shall be easily focused, switched, dimmed, accessorized and removed as desired. Track system shall have a twelve year warranty from date of shipment.

MECHANICAL Lighting Track shall be constructed of .070 (2mm) extruded aluminum with overall height of 1.42 (36mm) and overall width of 1.812 (46mm). Track shall have same overall dimensions and physical appearance for both one and two circuit models.

Track shall be available in nominal 4 foot (1.2m), 8 foot (2.4m), and 12 foot (3.7m) lengths, in Silver, Black, and White high temperature baked paint finish. Track shall be field cuttable to any length with a single cut.

Track system shall be available with End Feed, End Cap, Straight Mini-Joiner, Straight Joiner/Feeder, Flexible Joiner and L, T, and X Joiner/Feeders as standard components.

Track shall have the ability to be directly surface mounted. Track shall have pre-punched mounting slots for direct mounting to any surface. Track shall have the ability to: be mounted 1/2 inch (13mm) from a surface by extruded aluminum mounting clips, be suspended from a surface by a field cuttable stainless steel cable system, be suspended from a surface by a field cuttable steel stem system, and be mounted into UniTrack housing.

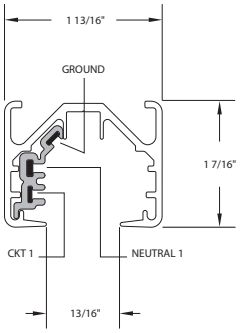
ELECTRICAL Lighting Track and components shall be UL and CUL listed, CE Certified, and comply with the National Electric Code standards for Lighting Track. One and two circuit Lighting Track shall be rated at 120/250 volt, 50/60 Hz. 2400 watts maximum each circuit. Each 20 amp/120 volt circuit shall be comprised of flat copper busbars and have a separate neutral busbar for each circuit busbar. The neutral busbar shall be oversized to be comparable to #10 gauge 30 amp wire to reduce the possibility of overheating due to non-linear loads and harmonics. **Track shall have integral wiring channels for six (6) additional #12 THHN wires to create three (3) additional 20 amp/120 volt circuits, which can be dropped into any Joiner/Feeder, for a total track power capacity of 100 amps.** A separate grounding busbar shall be integral in all track lengths. All busbars shall be insulated to prevent contact with aluminum extrusion.

Track shall have electric feed capability through all Joiner/Feeders (except Flexible Joiner and Straight Mini-Joiner) using either 1/2 or 3/4 U.S. trade size knock-outs (.875 diameter [22mm] or 1.125 diameter [29mm]). Joiner/Feeders can be electrically field modified by removing the Lexan™ cover and rerouting internal pre-wired jumpers. All Joiner/Feeders shall be available in Black, White, and Silver GE fiber reinforced Lexan™.

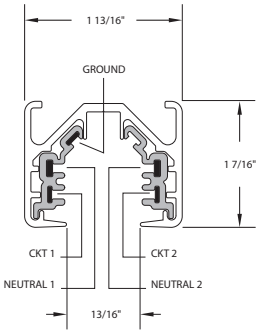
One and two circuit Lighting Track with separate neutral busbars shall have the ability to have each circuit separately dimmed as required when using standard voltage and low voltage fixtures with either magnetic or electronic transformers. Track shall have the ability to be dimmed or switched in selected sections in addition to dimming or switching an entire track configuration or track run.

FIXTURE FITTING INTERFACE Track shall accept GE fiber reinforced Lexan™ fixture fittings which positively lock into track and cannot be energized by the integral switch until safety interlock handle is in the closed position. Safety interlock shall also prevent fixture fitting removal from track unless the switch is in the "off" position. Upon insertion of fixture fitting into track, grounding connection from fixture fitting to track shall be automatically completed before any electrical contact is made with busbars. When removing fixture fitting from track, the grounding connection shall automatically be disconnected last. The fixture fitting shall recess into the track, creating a minimal profile below the track. Fixture fittings for magnetic low voltage fixtures shall be furnished with fuse of the correct ampere rating for integral transformer protection, and shall not be fused as a branch circuit.

One Ckt 120/250V Track



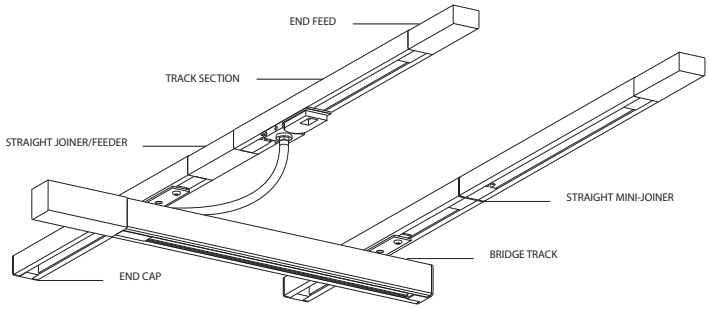
Two Ckt 120/250V Track



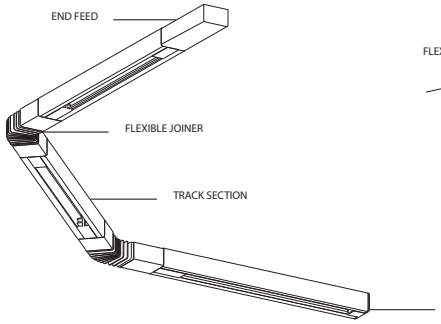
Lighting Services Inc

SURFACE TRACK (120/250V) • CONFIGURATIONS

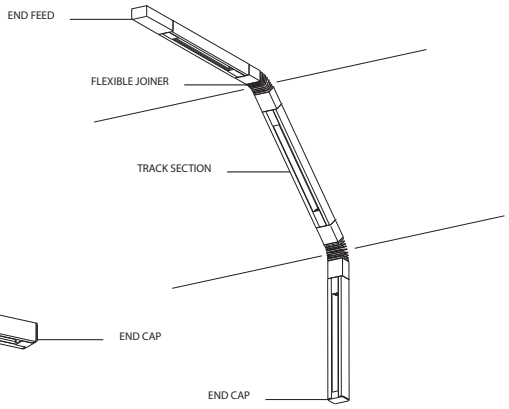
Bridge Track Application



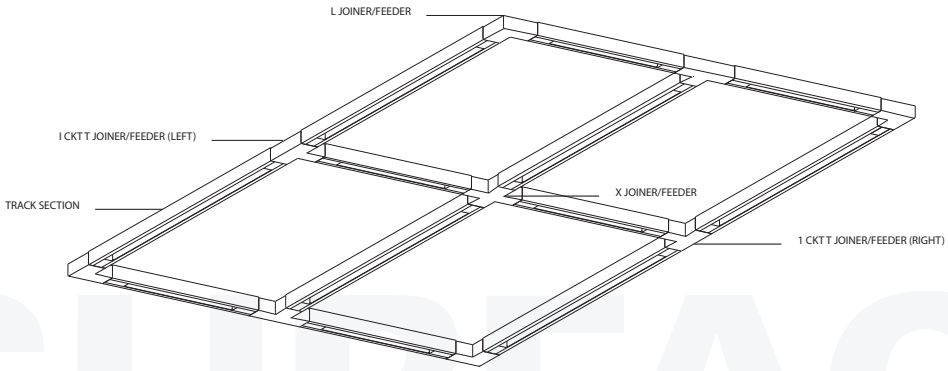
Ceiling Application/Horizontal Mount



Ceiling to Wall Application/Vertical Mount



One Circuit Configuration



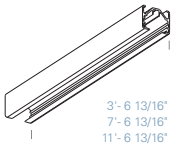
Lighting Services Inc

SURFACE TRACK (120/250V) • COMPONENTS

Key Features / Applications

UL and CUL listed, CE Certified, Dry Location • IBEW union made at LSI plant in USA • Specification grade heavy duty .070 (2mm) extruded aluminum track • 4 foot (1.2m), 8 foot (2.4m) and 12 foot (3.7m) field cuttable lengths • One circuit 20 amp or two circuit 40 amp capacity/120/250 volt • 100 amp total capacity when using integral wireways • Copper busbars equivalent to #12 AWG wire used as circuit and ground track conductors • Oversized copper busbars equivalent to #10 AWG wire used as neutral track conductors • Separate neutral track conductor used for each circuit • Separate copper grounding busbar used throughout track system • Black, White, and Silver finishes • All Joiner/Feeders, Flexible Joiners, Mini-Joiners, End Feeds and End Caps are injection molded of GE fiber reinforced Lexan™ • All Joiner/Feeders and Flexible Joiners are prewired and simply couple into track • All Joiner/Feeder circuits can be easily field modified by changing internal jumper wires • Fixture fitting recesses into track for minimum profile • LSI surface track can be mounted directly to any surface 5'-0" above finished floor.

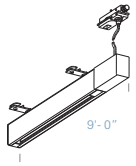
Surface Track Sections



120/250V Surface Track Sections are used in conjunction with an End Feed, End Cap and a variety of Joiner/Feeders to form track runs and configurations. Track Section lengths are nominal 4 foot (1.2m), 8 foot (2.4m) and 12 foot (3.7m) which are field cuttable.

Finish		Nominal Length 4 ft	8 ft	12 ft
Silver	One Ckt	31010	31020	31030
	Two Ckt	32010	32020	32030
Black	One Ckt	31210	31220	31230
	Two Ckt	32210	32220	32230
White	One Ckt	31310	31320	31330
	Two Ckt	32310	32320	32330

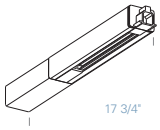
Bridge Track



120/250V Bridge Track is a complete, portable, field cuttable, surface UniTrack system that mechanically and electrically mounts to and spans parallel runs of LSI Track. Bridge Track provides an additional range of striking angles for track lighting fixtures or for centering a fixture over a target located between parallel runs of track up to 8 foot (2.4m) on center.

Finish		9 ft
Silver	One Ckt	31025
Black	One Ckt	31225
White	One Ckt	31325

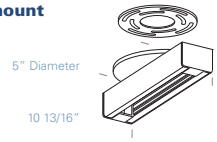
Security/Worklight Track



120/250V Security/Worklight Track is a separately fed one circuit Track Section, suitable for most LSI track fixtures, that integrates into any LSI Track run or configuration at any location. Consult fixture cutsheet. LSI fixtures (add suffix EF) mechanically lock into Security/Worklight Track by means of special hardware and do not have on/off switches.

Finish	All One Ckt 18" Joiner Section	18" End Feed Section	18" End Cap Section	18" Conduit End Feed Section
Silver	31050	31051	31052	31053
Black	31250	31251	31252	31253
White	31350	31351	31352	31353

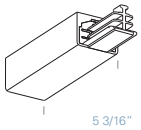
Unimount



120/250V Unimount is a compact canopy mount Track section which will accept most single LSI Track fixtures up to 500 watts.

Finish		
Silver	One Ckt	31161
Black	One Ckt	31261
White	One Ckt	31361

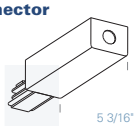
End Feed



120/250V End Feed is used in conjunction with a Canopy Kit for top feeding from a recessed outlet box and can also be top fed directly with cable.

Finish		
Silver	One Ckt	31100
	Two Ckt	32100
Black	One Ckt	31200
	Two Ckt	32200
White	One Ckt	31300
	Two Ckt	32300

End Feed for Conduit Connector



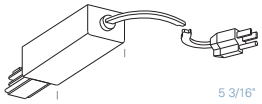
120/250V End Feed for Conduit Connector is used when feeding directly into the end of an End Feed. Connector supplied with 1/2" US trade size hole.

Finish		
Silver	One Ckt	31102
	Two Ckt	32102
Black	One Ckt	31202
	Two Ckt	32202
White	One Ckt	31302
	Two Ckt	32302

Lighting Services Inc

SURFACE TRACK (120/250V) • COMPONENTS

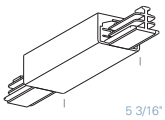
Portable Feed



120/250V Portable Feed is used when a portable or temporary track hookup is desired. Supplied with 15 foot #16 AWG-10 Amp/125 Volt 3 wire flexible cord with NEMA 5-15P grounding plug. Non-UL listed.

Finish		
Silver	One Ckt	**31101**
Black	One Ckt	**31201**
White	One Ckt	**31301**

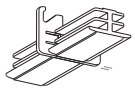
Straight Joiner/Feeder



120/250V Straight Joiner/Feeder is used to mechanically and electrically couple any two lengths of track in a straight line. Straight Joiner/Feeder can also be top fed to energize the track from a recessed outlet box when used in conjunction with appropriate Canopy Kit or can be top fed directly with cable.

Finish		
Silver	One Ckt Two Ckt	**31104** **32104**
Black	One Ckt Two Ckt	**31204** **32204**
White	One Ckt Two Ckt	**31304** **32304**

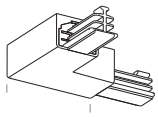
Straight Mini-Joiner



120/250V Straight Mini-Joiner is used to mechanically and electrically couple any two lengths of track in a straight line. Add .125 (3mm) for Straight Mini-Joiner when calculating overall lengths of straight runs or configurations (overall lengths are not the same as when using Straight Joiner/Feeder). Not for use as feeder.

Finish		
Silver	One Ckt Two Ckt	**31111** **32111**
Black	One Ckt Two Ckt	**31211** **32211**
White	One Ckt Two Ckt	**31311** **32311**

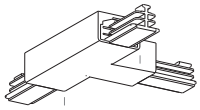
L Joiner/Feeder



120/250V L Joiner/Feeder is used to mechanically and electrically couple any two lengths of track in an L right angle configuration. This L Joiner/Feeder can also be top fed to energize the track from a recessed outlet box when used in conjunction with appropriate Canopy Kit or can be top fed directly with cable.

Finish		
Silver	One Ckt Two Ckt	**31105** **32105**
Black	One Ckt Two Ckt	**31205** **32205**
White	One Ckt Two Ckt	**31305** **32305**

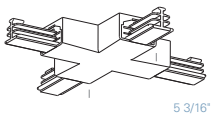
T Joiner/Feeder



120/250V T Joiner/Feeder is used to mechanically and electrically couple any three lengths of track in a T configuration. This T Joiner/Feeder can also be top fed to energize the track from a recessed outlet box when used in conjunction with appropriate Canopy Kit or can be top fed directly with cable. Internal Joiner wiring can be field modified. Note that in the one circuit version, a right or a left T must be ordered and must be used directly opposite each other when used in a configuration so that busbar continuity is maintained. For two circuit track, a left and right T is not necessary.

Finish		Left Joiner	Right Joiner
Silver	One Ckt Two Ckt	**31106** **32108**	**31107** **32108**
Black	One Ckt Two Ckt	**31206** **32208**	**31207** **32208**
White	One Ckt Two Ckt	**31306** **32308**	**31307** **32308**

X Joiner/Feeder



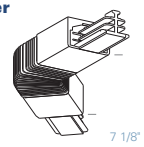
120/250V X Joiner/Feeder is used to mechanically and electrically couple any four lengths of surface track in an X configuration. This X Joiner/Feeder can also be top fed to energize the track from a recessed outlet box when used in conjunction with appropriate Canopy Kit or can be top fed directly with cable.

Finish				
Silver	One Ckt	**31109**	Two Ckt	**32109**
Black	One Ckt	**31209**	Two Ckt	**32209**
White	One Ckt	**31309**	Two Ckt	**32309**

Lighting Services Inc

SURFACE TRACK (120/250V) • COMPONENTS

Flexible Joiner



120/250V Flexible Joiner is used to mechanically and electrically couple any two lengths of surface mount track to create obtuse angles from 90° through 270°. The Flexible Joiner can be flexed in either horizontal or vertical planes. Not for use as feeder.

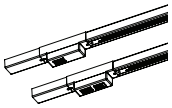
Finish				
Silver	One Ckt	**31112**	Two Ckt	**32112**
Black	One Ckt	**31212**	Two Ckt	**32212**
White	One Ckt	**31312**	Two Ckt	**32312**

End Cap

120/250V End Cap is used for mechanically ending any straight run, individual Track Section, or open configuration Track Section.

Finish		
Silver	One & Two Ckt	**30103**
Black	One & Two Ckt	**30203**
White	One & Two Ckt	**30303**

Current Limiter



LSI Track Current Limiters integrate directly into 1 and 2 circuit track runs in Black, White and Silver finishes. Available amperage rating include: (0.5) amp (60 watts), (1) amp (120 watts), (1.5) amp (180 watts), (2) amp (240 watts), (2.5) amp (300 watts), (3) amp (360 watts), (5) amp (600 watts), (8) amp (960 watts) and (12) amp (1440 watts). Other amperages available, consult factory.

California Energy Commission (CEC) approved and Title 24 compliant.

See spec sheet on LSI website for ordering information.

Adjustable Angle Bracket

The Adjustable Angle Bracket for Flex Joiner is designed to attach to cable mounted track. This assembly locks the set angle of a Flex Joiner when there is no rigid mounting means.

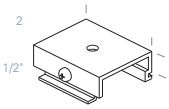
Finish		
Silver	One & Two Ckt	**30116**
Black	One & Two Ckt	**30216**
White	One & Two Ckt	**30316**

Raceway Cover

Field cuttable Raceway Covers are used to enclose additional lay-in circuit wiring in top section of track.

	Nominal Length		
Finish	**4 Ft**	**8 Ft**	**12 Ft**
Galvanized	**30613**	**30614**	**30615**

Surface Hanger Clip Kit



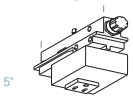
Extruded Surface Hanger Clips space track .50 (13mm) from a surface to create a floating look or when mounting to an uneven surface. For normal usage, LSI recommends two hanger clips per 4 foot (1.2m) length, two hanger clips per 8 foot (2.4m) length and three hanger clips per 12 foot (3.7m) length. Two clips per package. 1/4" diameter hole.

Finish		
Silver	One & Two Ckt	**30025**
Black	One & Two Ckt	**30225**
White	One & Two Ckt	**30325**

Lighting Services Inc

SURFACE TRACK (120/250V) • COMPONENTS

Power Receptacle Adapter



120/250V Power Receptical Adapter provides a convenient switched and fused U-Ground receptacle for power and is rated at 5A-120V. ETL listed.

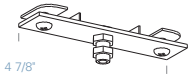
Finish		
Silver	One & Two Ckt	**31160**
Black	One & Two Ckt	**31260**
White	One & Two Ckt	**31360**

Display Hook

Display Hook is used to mechanically hang an item from the track without electrifying it. Do not exceed 20 lbs. at minimum spacing of two feet.

Finish		
Silver	One & Two Ckt	**30761**

Weight Support Bar



Weight Support Bar provides threaded nipple and nuts to mount an item to track without electrifying it. Do not exceed 20 lbs. at minimum spacing of two feet. Nipple size 1/8-27 NPS (.406 diameter).

Finish		
Silver	One & Two Ckt	**30762**

Track Closure Cover

Field cuttable Noryl Track Closure Covers are used to enclose the open face of the track, and simply snap into place.

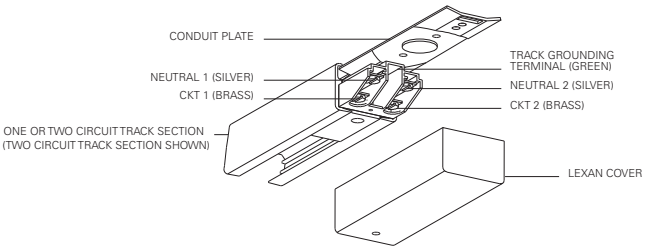
	Nominal Length
Finish	12 Ft
Silver	**30167**
Black	**30267**
White	**30367**

Lighting Services Inc

SURFACE TRACK (120/250V) • INSTALLATION

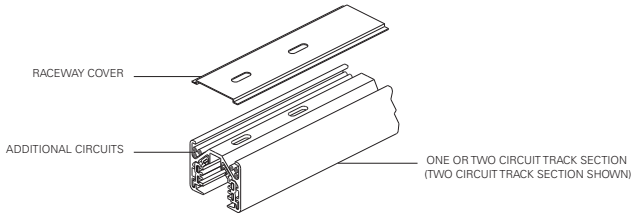
Electrical

Remove the Lexan™ cover from any End Feed or Joiner/Feeder, bring wires through combination 1/2, 3/4 U.S. trade size knock-out (.875 diameter [22mm], 1.125 diameter, [29mm]) in conduit plate and attach conductors to identified terminals. Joiner/Feeders can be electrically field modified after removal of Lexan™ cover by rerouting internal pre-wired jumpers.



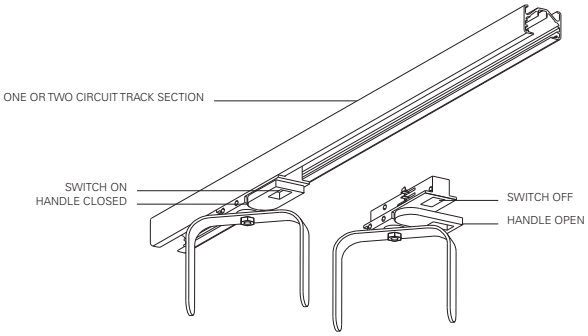
Additional Circuits

LSI Track has integral wiring channels for six additional #12 THHN wires to create three additional 20 amp circuits with separate neutrals. Place conductors in wiring channels and slide raceway covers into track prior to mounting.



Installing LSI Fixtures

To insert a fixture fitting into the track, the switch must be in the "off" position, with the handle open. Insert the fixture fitting straight up into the track until it seats evenly, close handle completely, switch on. If using one circuit track, make sure that the brass contacts which protrude from the side of the fixture fittings are inserted facing the copper busbars. If using two circuit track, inserting the fixture fitting in one direction will connect to circuit one. Removing and reversing the direction of the fitting will connect to circuit two.



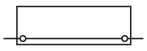
Lighting Services Inc

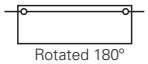
TYPICAL WIRING DIAGRAMS

Diagrams apply to 120V Surface Track, 277V Surface Track and Recessed Track Systems

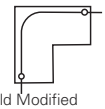
Single Circuit

Straight Joiner/Feeder

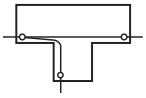


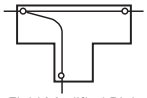


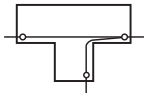
L Joiner/Feeder

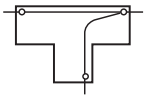


T Joiner/Feeder

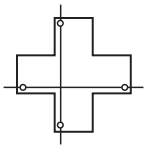


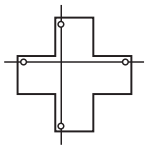


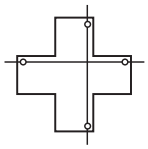


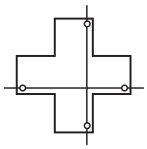


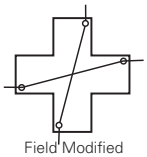
X Joiner/Feeder

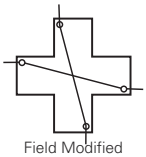












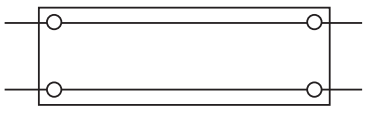
Flexible Joiner

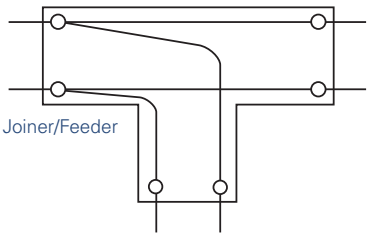
Notes:

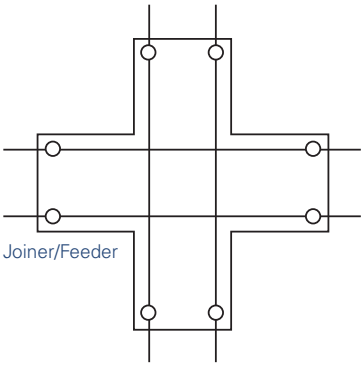
All diagrams shown are installed view, not RCP.

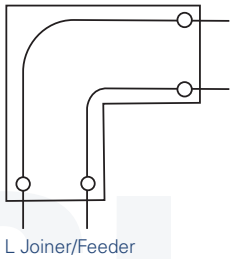
Except as noted, all modifications can be done simply and quickly on the job with a Philips and straight blade screwdriver

Two Circuit









* Prewired internal jumpers cannot be modified.

MEDMASTER™

Luminaires for Patient/Exam Rooms

MAEC SERIES

PROJECT INFORMATION

Job Name _____

Fixture Type _____

Catalog Number _____

Approved by _____

PRODUCT FEATURES:

- » Ceiling mount – 8"×48"
- » Product must be specified and ordered in pairs
- » Indirect Ambient and Direct Exam functions
- » Adjustable MR16 Reading light
- » Ingress Barrier door provides consistent surface for ease of cleanability

*Shown with Reading Light

SPECIFICATIONS

HOUSING: 20-gauge CRS; one-piece seam welded construction. 18-gauge housing flange with mitered and welded corners. White TGIC polyester powder coat – 5-stage pre-treatment. Salt spray test: 1,000 hours; Reflectance: 92%.

DOORFRAME: Heavy duty extruded marine grade aluminum with clear satin anodized finish. Doorframe supported to housing with aircraft cables (IB-AC) to provide NSF2 listing, or an optional continuous hinged doorframe (IB-HD). Select in ordering options below. Phillips-head stainless steel fasteners secure door to housing- six (6) with IB-AC and two (2) with IBHD. Closed cell silicone gasket seals the doorframe to housing. Lens sealed to extruded aluminum frame using a vinyl gasket.

OPTIC: Clear impact-resistant acrylic outer lens with inner high-efficiency diffuser. Exam function: direct 15° asymmetric linear overlay optic. Ambient function: Indirect high-efficiency TGIC painted white reflector. Optional reading light MR16 LED 20° beam with field aiming capability (90° rotation and 0-45° vertical).

LED MODULE: AMBIENT/EXAM: Serviceable mid-power LED array. See Ordering Information for CCT options. 3-step MacAdam variation allowance. 82 CRI minimum. READING: Single 6.5W MR16 LED lamp; 3000K CCT with 80 CRI minimum; non-dimming.

DRIVER: 120-277VAC or 347VAC, 50/60Hz electrical input (PF ≥ 0.9, THD < 20%). Minimum 85% electrical efficiency. Serviceable constant-current programmable driver. 0-10V dimming with 1-100% range and dim-to-dark capabilities (non dim-to-dark with 347V); 165µA max. source current per circuit. Specified-voltage required for optional Reading lamp. Optional LVCD controls low-voltage patient interface, controlling the ambient function independently with dimming control and the exam function independently without dimming. Optional secondary conduit entry available.

INSTALLATION: GRID MOUNT: Designed for 1" grid. Includes integral brackets for securing hanger wire. FLANGE MOUNT: Supplied with Drywall Frame Kit.

WARRANTY: Limited five (5) year warranty.

LISTINGS: Luminaire is certified to UL Standards by Intertek Testing Laboratory for Wet Locations and Non-IC installation. UL certified IP65 per IEC 60598. NSF2 Splash/Non-Food Zone (IB-AC only).

LED · ETL · NSF · IP65

ORDERING INFORMATION (Ex: MAEC-48-G-38L/38L/6L-35K8-DIM1-277-IB-AC-RLRS-LVCD)

Model	Length	Mounting	Lamp Power	Lamp Color	Driver Type	Voltage	Doorframe Option	Reading Light Orientation	Options
MAEC	48				DIM1		IB-		

Nominal Length
48 48"

Mounting Style
G Grid (1")
F Flange (with Drywall Frame Kit)

Lamp Power
40L/40L 40 Watt Ambient/40 Watt Exam (Two Function)
38L/38L/6L 38 Watt Ambient/38 Watt Exam/6 Watt Reading (Three Function)

Lamp Color (Ambient/Exam)
30K8 3000K/82CRI min
35K8 3500K/82CRI min
40K8 4000K/82CRI min
50K8 5000K/82CRI min

Driver Type
DIM1 0-10V Dimming to 1%

Voltage
120 120 Volts
277 277 Volts
347 347 Volts
DV 120-277 Volts

Doorframe Option
AC Ingress Barrier with Aircraft Cables
HD Ingress Barrier with Continuous Piano Hinge (n/a with NSF2 listing)

Reading Light Orientation▲
RLRS Reading Light, Right Side Mount
RLLS Reading Light, Left Side Mount

Options
LEL* 8.4W Emergency Battery Backup (wired to exam)
AMF Antimicrobial Finish on exposed surfaces
FS Fuse & Holder
LVC Low Voltage Controller (Click here for specifications)
LVCS Low Voltage Controller with Secondary Conduit Entry (Click here for specifications)
LVCD Low Voltage Controller with Dimming (Click here for specifications)
LVCDS Low Voltage Controller with Dimming and Secondary Conduit Entry (Click here for specifications)

* n/a with 347V
▲ Three-function configurations only. Luminaires with reading light option must be specified in pairs. Specify right and left side orientation, per application. Not available with DV Voltage option

ACCESSORIES ORDERED SEPERATELY
MPWS Low Voltage Wall Switch (Click here for Specifications)

KENALL® | www.kenall.com | P: 800-4-Kenall | F: 262-891-9701 | 10200 55th Street Kenosha, Wisconsin 53144, USA
A brand of legrand®

MAEC-070819

For additional photometry, go to www.kenall.com

MEDMASTER™

Luminaires for Patient/Exam Rooms

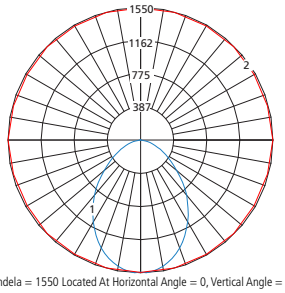
MAEC SERIES

PERFORMANCE

Model	Function	Lamp Power	Initial Delivered Lumens, by Lamp Color (lm) 30K8	35K8	40K8	50K8	Efficacy (lm/W)	Input Power (W)	Estd. L70 LED Life (hrs)
Two-Function	Ambient	40L	2,953	3,003	3,102	3,195	65 - 70	45	80,000
	Exam	40L	3,536	3,596	3,715	3,826	77 - 83	46	80,000
	Ambient + Exam	40L/40L	6,396	6,503	6,718	6,920	70 - 76	91	80,000
Three-Function	Ambient	38L	3,071	3,123	3,226	3,323	70 - 76	44	80,000
	Exam	38L	3,527	3,586	3,705	3,816	81 - 88	44	80,000
	Ambient + Exam	38L/38L	6,490	6,599	6,817	7,022	74 - 81	87	80,000
	Reading	6L	463				56	8	35,000

Photometry tested to the IESNA LM-79-08 standard by an ILAC/ISO17025 accredited laboratory. For photometric data, please go to www.kenall.com.

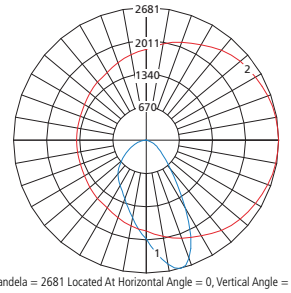
Model: MAEC-48-w-38L-38L-6L-40K8-DIM1-xxx-yy-zzz (Ambient)



Maximum Candela = 1550 Located At Horizontal Angle = 0, Vertical Angle = 2.5

1 - Vertical Plane Through Horizontal Angles (0-180) (Through Max. Cd.)
2 - Horizontal Cone Through Vertical Angle (2.5) (Through Max. Cd.)

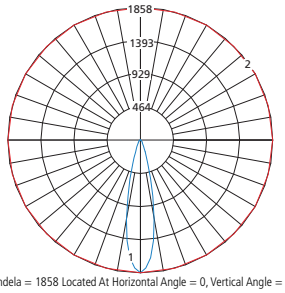
Model: MAEC-48-w-38L-38L-6L-40K8-DIM1-xxx-yy-zz-RLLS (Exam)



Maximum Candela = 2681 Located At Horizontal Angle = 0, Vertical Angle = 15

1 - Vertical Plane Through Horizontal Angles (0-180) (Through Max. Cd.)
2 - Horizontal Cone Through Vertical Angle (15) (Through Max. Cd.)

Model: MAEC-48-w-38L-38L-6L-40K8-DIM1-xxx-yy-zzz (Reading)

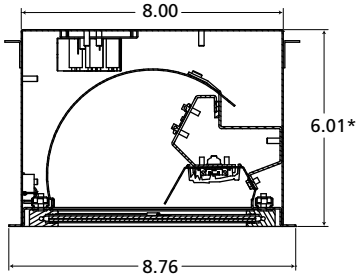


Maximum Candela = 1858 Located At Horizontal Angle = 0, Vertical Angle = 0

1 - Vertical Plane Through Horizontal Angles (0-180) (Through Max. Cd.)
2 - Horizontal Cone Through Vertical Angle (0) (Through Max. Cd.)

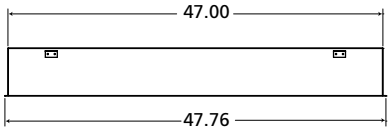
DIMENSIONAL DATA

CROSS SECTION

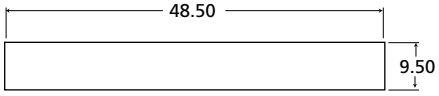


* ADD 0.16" FOR LEL

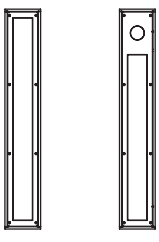
SIDE VIEW



FLANGE MOUNT CEILING CUTOUT

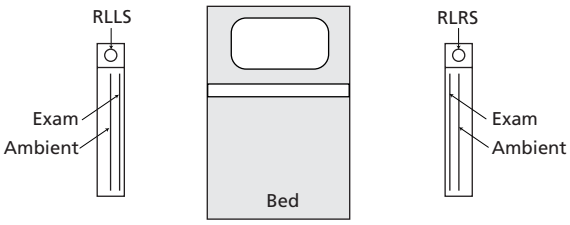


BOTTOM VIEW



Two Function | Three Function

READING AND EXAM LIGHT LAYOUT (Must be specified in pairs)



Specification

ADVANCED HIGH CEILING

Whiz 2.0 - Standard

METEOR

High lumen compact luminaire with lumen output 12400 – 35400lm. Additional features include IP65 and outdoor/Natatorium rating.

Quantity		Type	
Project		Note	

Electrical System

- 13900lm (120W)
  19600lm (170W)
  26700lm (240W)
  35400lm (300W)
- Power Input: Universal (120-277V); 347-480V
- Operating Temperature: -40°F~112°F
- Surge Protection: 4KV
- Power Factor Greater than 0.9

LED Technology

- 3000K, 3500K, 4000K, 5000K
- 75 CRI, 85 CRI
- Beam Angle: 25°, 40°, 60° and 100° (with diffuser)
- Rated Life > 100,000 hours (L70)
- Lumen Maintenance > 0.90 at 60,000 hours

Advanced Dimming

(Proprietary VX Driver is incorporated to all dimming options for video flicker-free lighting)

- Standard 0-10V: dims to 10%
- Superior 0-10V: dims to 1%
- LDE1: Hi-Lume 1% EcoSystem (UNV only)
- LTE: Hi-Lume 1% 2-Wire TRIAC (120V only)
- DALI: dims to 10%
- DMX: high resolution dims to 0.1%
  (Supports ANSI E1.20 RDM protocol)

Housing

- Diameter: 16.24" (420mm)
- Material: Die-Cast Aluminum, Tempered Glass
- Weight: 33lbs

Mounting

- Stem 2ft, 4ft
- Adjustable Aircraft Cable 10ft
- Uplight 2ft, 4ft
- Adjustable Uplight 2ft, 4ft

Warranty

- 5 years limited warranty.

Listing

- ETL Damp Location Listed
- DLC Listed
- UL924

UL 924 ETL Intertek DLC QPL LISTED

Not all Whiz 2.0 are DLC qualified.
For all qualified products.
Please visit: www.designlights.org/qpl

Specification

ADVANCED HIGH CEILING

Whiz 2.0 - Standard

METEOR

How To Specify:
Ordering Example: WS2-240-507-UNV-DMX-60-BLK-ST2-EMP

Model	Wattage	CCT / CRI	Voltage	Dimming
WS2			UNV	
WS2 Whiz 2.0 Series	**120** 120W **170** 170W **240** 240W **300** 300W	**507** 5000K / CRI75 **308** 3000K / CRI85 **358** 3500K / CRI85 **408** 4000K / CRI85	**UNV** 120-277V **HVT** 347-480V **120** 120V	**NOD** Non-Dimming **STV** Standard 0-10V dims to 10% **SPV** Superior 0-10V dims to 1% **DMX** DMX dims to 0.1% (XLR Sockets) **DMX(RJ45)** DMX dims to 0.1% (RJ45 Sockets) **LTE**[1] Hi-Lume 1% 2-Wire TRIAC (120V only) **LDE1**[1] Hi-Lume 1% EcoSystem (UNV only) **DALI** DALI dims to 10% [1]Option only compatible with 120W, 170W.

Beam Angle	Finish	Mounting	Accessories
25 25º **40** 40º **60** 60º **WD*** 100º (with diffuser) *Please factor in change in lumen output with diffuser (-20% with WD; -12% with other degrees).	**BLK** Black **WHT** White	**ST2** Stem 2ft **ST4** Stem 4ft **AD10*** Adjustable Cable 10ft **UP2*** Uplight Stem 2ft **UP4*** Uplight Stem 4ft **AUP2*** Adjustable Uplight 2ft **AUP4*** Adjustable Uplight 4ft *Option is not compatible with OCC.	**OCC**[1] Occupancy Sensor (Enlighted) **EMP** Remote Emergency Pack **DF**[2] Diffuser **WG**[3] Wire Guard **SNT**[4] Snoot **GSV**[5] Glare Shield Visor [1] Option is ONLY compatible with NOD, and must be ordered with WG. Not available with 300W. OCC sensor is a mesh network-controlled device. [2]Please factor in change in lumen output with diffuser (-20% with WD; -12% with other degrees). [3]Please factor in change in lumen output of -14%. [4]Please factor in change in lumen output of -30%. [5]Please factor in change in lumen output of -25%.

DesignLights Consortium™ Qualified Luminaires:

DLC QPL Model Number: WS2-300-408
Not all product variations listed on this page are DLC qualified.
To ensure that a specific model is qualified, visit www.designlights.org/search.

Specification

ADVANCED HIGH CEILING

Whiz 2.0 - Standard

METEOR

Delivered Lumens*

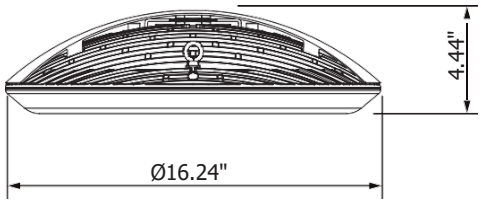
Wattage / CCT	120W	170W	240W	300W
	Beam Angle: 40°			
5000K	13900 lm	19600 lm	26700 lm	35400 lm
4000K	13300 lm	18900 lm	22100 lm	29700 lm
3500K	12500 lm	17700 lm	21400 lm	28800 lm
3000K	12400 lm	17510 lm	21200 lm	28500 lm

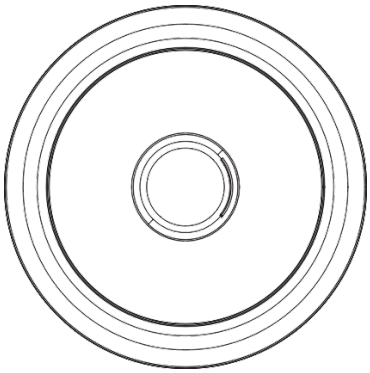
*Tolerance±8%

Current Consumption

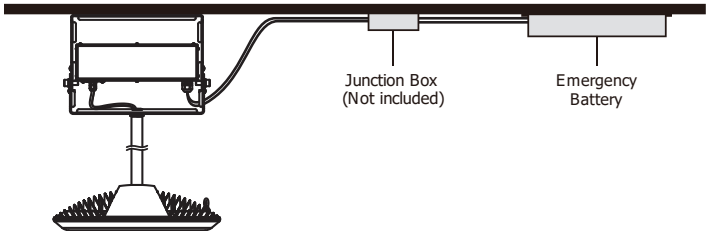
Volt / Wattage	120V	277V
120W	**1.1A**	**0.48A**
170W	**1.56A**	**0.68A**
240W	**2.02A**	**0.87A**
300W	**2.75A**	**1.19A**

Dimensions

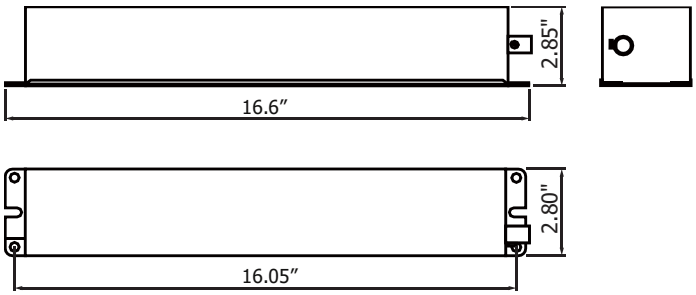




Remote Emergency Pack



16.6" x 2.8" x 2.85" (mounting center - 16.05")



Emergency Pack Lumen Output Table

CCT	3000K	3500K	4000K	5000K
Lumen	1900 lm	1920 lm	1980 lm	2360 lm

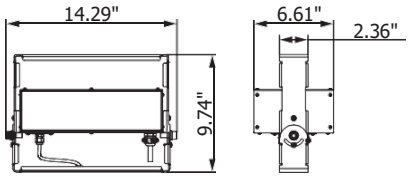
Specification

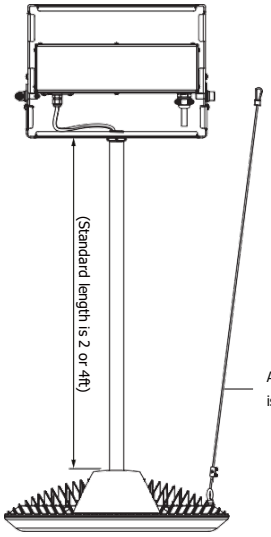
ADVANCED HIGH CEILING

Whiz 2.0 - Standard

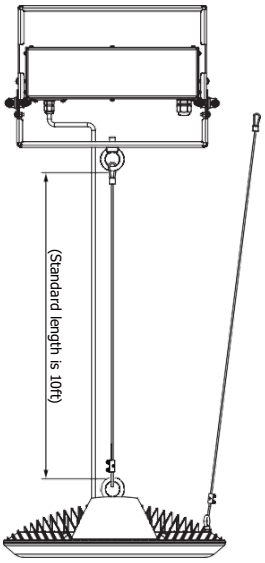
METEOR

Mounting Options

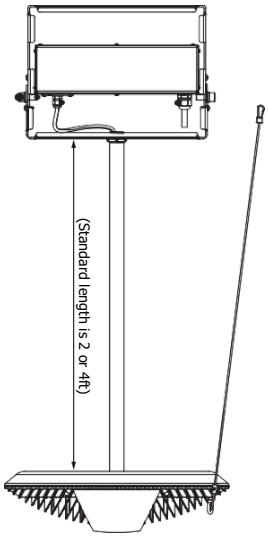




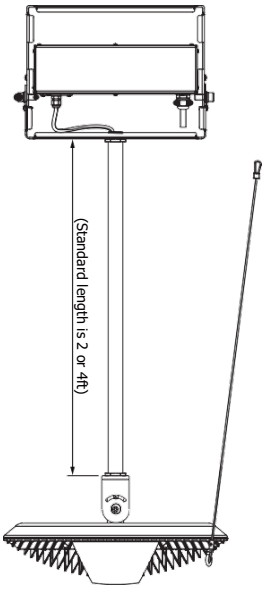
Stem



Adjustable Aircraft Cable



Uplight



Adjustable Uplight

Specification

ADVANCED HIGH CEILING

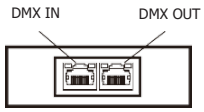
Whiz 2.0 - Standard

METEOR

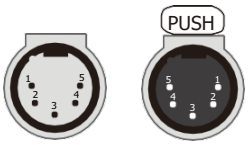
DMX Requirements*

The Whiz 2.0 LED fixture with DMX is a ONE CHANNEL DMX unit.
When placing order, please indicate DMX address. (The DMX address will be listed on the back of the fixture.)
The LED fixture provide RJ45 Socket or XLR socket to connect. (DMX cable NOT included.)
The final fixture should be terminated by the use of DMX Terminator (by others).

RJ45 Sockets



XLR Sockets



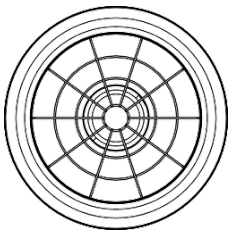
CONNECTION	RJ45 (CAT5e)	5-PIN XLR
Common	WHITE/BROWN(PIN7) & BROWN (PIN 8)	PIN 1
Signal -	ORANGE (PIN 2)	PIN 2
Signal +	WHITE/ORANGE (PIN 1)	PIN 3
Spare	-	PIN 4
Spare	-	PIN 5

Compatible DMX Cabling List

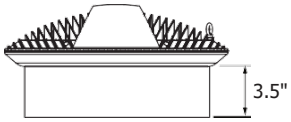
DMX uses a cable consisting of two twisted pairs plus a shield to carry data. The cable must be specifically impedance matched for the digital DMX signal, meaning that microphone cable or other non-rated cable **must not be used to carry DMX**. Network cable (Cat5, 5e or 6 cable) may be used to carry DMX in an installation; however special consideration must be given to shielding and termination. Under no circumstances should solid core cable like Cat5 be terminated into a screw down connector.

Meteor recommends the use of Belden 9729 for DMX installation. Belden 9729 is a two pair cable, which allows for a spare pair for 'out and back' type terminations if needed. Below is a list of other compatible Belden cables.

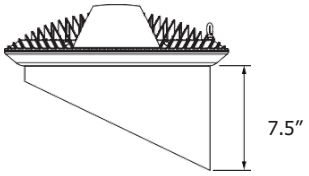
Accessory



Wire Guard



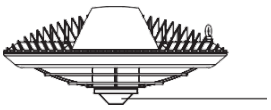
Snoot



Glare Shield Visor

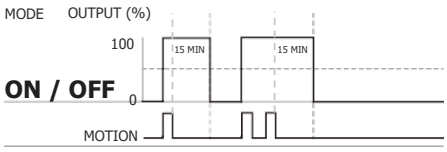
Occupancy Sensor

* Not available with any dimming option.
* Mesh network-controlled device.



Occupancy Sensor

Occupancy Sensor Operation



NOT USED

Day-Brite CFI by signify

Linear

FluxStream strip

FSS 2', 3', 4', & 8'

Control options available

Project:

Location:

Cat.No:

Type:

Lumens: Qty:

Notes:

Day-Brite / CFI FluxStream LED strip is a high performing luminaire delivering smooth diffuse light ideal for light industrial, commercial and residential applications with unparalleled energy efficiency.

Ordering guide – standard & wireless controls

example: FSS440L840-UNV-DIM

Series	Length (nominal)	Lumens[2] (nominal)	Color temp. (K)	Voltage	Driver	Options
FSS			–	–	–	

FSS	FluxStream strip	**2** 2'	**20L** 2000 **30L** 3000	**830** 80 CRI, 3000K **835** 80 CRI, 3500K **840** 80 CRI, 4000K **850**[3] 80 CRI, 5000K	**UNV** Universal voltage 120-277V **120**[4] 120V **277**[4] 277V **347**[5] 347V	**DIM**[11] Dimming **SDIM**[6,7] Step dimming to 40% input power **XDIM**[4,6,7] MarkX phase dimming **DALI**[8] DALI	**EMLED**[5,6,9] Factory wired Bodine BSL310LP integral emergency pack. Nominal 1100lm **ER100**[12,13,17] UL924 listed bypass sensor relay, factory installed between driver & sensor PS/PI (Interact Pro compatible) **ER100/HVPS**[12,13,17] UL924 listed sensor bypass relay, factory installed between driver & sensor for 347/480 Power Sense (Interact Pro compatible) **ER100/HVPI**[12,13,17] UL924 listed sensor bypass relay, factory installed between driver & sensor 347/480 Power Interrupt (Interact Pro compatible) **GTD/E**[12] UL924 listed Bodine GTD factory installed on driver input **GTD/SNSR**[12,13] UL924 listed Bodine GTD factory installed between driver & sensor (alternate option to ER100) **SWZCS**[10,15] Interact Pro scalable sensor with integral daylight & occupancy sensing, advanced grouping with dwell time **SWZDT**[10] SpaceWise sensor, daylighting and occupancy, advanced grouping, with dwell time **RADIO**[10] Integral Interact Pro RF sensor, enables wireless connected lighting control **SWZCSH**[14] Interact Pro scalable high bay sensor with integral daylight & occupancy sensing, advanced grouping with dwell time for high mounting heights **IAOSB**[10,15] Interact Pro Enterprise advanced wireless sensor bundle, integral SC1500 w/IoT capabilities for enterprise scale projects **LSXR10** 120-347V motion sensor, factory installed on end cap **LSXR10ADC**[10] 120-347V motion sensor with photocell and hi/lo trim dimming, factory installed on end cap **PAF** Paint after fabrication for extra corrosion resistance (white) **BK** Matte black paint color **ST** Satin aluminum paint color **BAC**[18] Meets the requirements of the Buy American Act of 1933 (BAA)
		3 3'	**30L** 3000				
		4 4'	**30L** 3000 **40L** 4000 **55L** 5500 **70L** 7000				
		8[1] 8'	**60L** 6000 **80L** 8000 **110L** 11000 **140L** 14000				

Ordering guide – PoE controls example: FSS440L840-LV-POE-IAO

Series	Length (nominal)	Lumens[2] (nominal)	Color temp. (K)	Voltage	Driver	Options
FSS			–	LV –	POE –	

FSS	FluxStream Strip	**4** 4'	**30L** 3000 **40L** 4000 **60L** 6000	**830** 80 CRI, 3000K **835** 80 CRI, 3500K **840** 80 CRI, 4000K **850** 80 CRI, 5000K	**LV** Low voltage	**POE** Power over ethernet	**IAO** Interact PoE daylighting and occupancy sensor, enables wired connected lighting control **EMPOE**[16] 600lm integral emergency driver and battery pack. **PAF** Paint after fabrication for extra corrosion resistance (white) **BK** Matte black paint color **ST** Satin aluminum paint color **IAOSB** Interact PoE advanced wired sensor bundle, integral SC2000 w/IoT capabilities for enterprise scale projects
		8[16] 8'	**60L** 6000				

1 8' is tandem (2) 4' lenses with single piece 8' body.
2 Nominal delivered lumens at 25°C ambient.
3 Not available in 3' model.
4 XDIM option only available with 120V.
5 347V with EMLED only available in 8' models.
6 Not available in 2' or 3' model.
7 Not available in 4' 70L model or 8' 140L model.
8 DALI available up to 80L models only, consult factory for other options.
9 EMLED on 8' models illuminates 4' section in emergency mode.
10 Available with DIM driver option only.
11 Integral controls options dimmable to 5% via wireless wall switch. Non-integral controls configurations are 0-10V dimmable to 1%.
12 Must be installed in conjunction with a UL1008 device.
13 Must be ordered with an integral sensing option.
14 High bay motion detector. Motion sensing zone is extremely limited if used below 15' mounting height.
15 Must order IRT9015 Interact commissioning remote with each system order.
16 EMLED on 8' models illuminates 4' section in emergency mode.
17 ER100 options not available in 2', 3' only has availability when selecting UNV.
18 Failure to properly select the "BAC" suffix could result in you receiving product that is not BAA compliant product with no recourse for an RMA or refund. This BAC designation hereunder does not address (i) the applicability of, or availability of a waiver under, the Trade Agreements Act, or (ii) the "Buy America" domestic content requirements imposed on states, localities, and other non-federal entities as a condition of receiving funds administered by the Department of Transportation or other federal agencies.
19 Consult Signify to confirm whether specific accessories are BAA-compliant.

Accessories[19] (order separately)

- **FSSD2L** - 2' Diffuse replacement lens
- **FSSD3L** - 3' Diffuse replacement lens
- **FSSD4L** - 4' Diffuse replacement lens (order two for 8' models)
- **FSSWG4** - 4' wire guard (order two for 8' models)
- **FSTH** - Sliding hanger bracket (set of two)
- **LSXR10** - Low bay PIR motion sensor, 120-277V (not available with PoE)
- **LSXR10ADC** - Low bay PIR motion sensor with photocell and hi/lo trim dimming, 120-277V (not available with PoE)
- **FSSDEK** - Decorative plastic end cap (set of two)

(See last page for details and more options)

SWZCS accessories[19] (order separately)

- **IRT9015** – handheld remote for grouping and configuration(at least one remote required for any SWZCS installation).
- **UID8451/10** – Wireless Dimmer Switch Selector
- **UID8461/10** – Wireless Scene Selector

General notes

Many luminaire components, such as reflectors, refractors, lenses, sockets, lampholders, and LEDs are made from various types of plastics which can be adversely affected by airborne contaminants. If sulfur based chemicals, petroleum based products, cleaning solutions, or other contaminants are expected in the intended area of use, consult factory for compatibility.

PAF (Paint after fabrication) option is required for all products that will be used in a damp or humid location, such as under a canopy or covered parking area.

Not all product variations listed on this page are DLC qualified. To ensure that a specific model is qualified, visit www.designlights.org/search

interact ready.

FSS FluxStream LED strip

2', 3', 4' and 8'

Features

- Compact design for installation in tight spaces.
- Frosted acrylic diffuser provides wide light distribution and superior glare control.
- Diffuser and LED plate snap into place allowing tool-free access to LED boards and driver.
- 2', 3', 4' and 8' tandem lengths available to accommodate many field applications.
- Up to 100,000 hour predicted L70 LED lumen maintenance provides long service life to reduce maintenance costs.
- Can be surface mounted on ceilings or walls, or suspended via chain, pendants or cables.
- Wall mountable – ADA compliant.
- Ideal for cold applications (-20°C).
- Continuous row mounting using standard end caps. No extra parts needed.
- 7/8" knock out provided at each end and on base of luminaire. Note: Center knockout is covered and not useable in 4' version with EMLED option.
- Multiple driver options available with 0-10V as standard.
- Enclosed lens minimizes penetration of dust, insects, and other debris into the LED compartment.
- 8' tandem unit is two 4' optical assemblies with a center mullion on a single full length chassis.
- Integral controls options include sensor mounted in control module extension mounted on fixture end (see dimension drawing).
- Fluxstream luminaires are Designlights Consortium® qualifed. Please see the DLC QPL list for exact catalog numbers www.designlights.org/QPL.
- 5 year manufacturer's limited warranty. Visit signify.com/warranties for complete warranty information.

Finish

- Baked white acrylic matte high reflectance paint finish.
- PAF (Paint after fabrication) option, which is required for all products that will be used in damp or humid locations, such as a canopy or covered parking area, provides extra corrosion resistance.

Shielding

- Contoured frosted acrylic lens.

Electrical

- LED boards and drivers are RoHS (Restriction of Hazardous Substances) compliant. Total system life rated at 50,000 hours. Predicted L70 lifetime based on LED manufacturer's supplied LM-80 data and in-situ laboratory testing.
- Integral emergency driver with EMLED option. To estimate lumen output in emergency mode, multiply emergency pack wattage by efficacy, then by 1.10.
- The GTD/E option is used to bypass wall switches and allow luminaire operation on auxiliary power. Generator transfer requires installation in conjunction with a UL1008 listed device.
- The GTD/SNSR option is used to bypass integrated sensor control in the event of utility power loss. Generator transfer requires installation in conjunction with a UL1008 listed device.

Materials

- Heavy gauge cold rolled steel housing, LED plate, and end caps.

Labels

- cETLus listed.
- Suitable for damp locations.

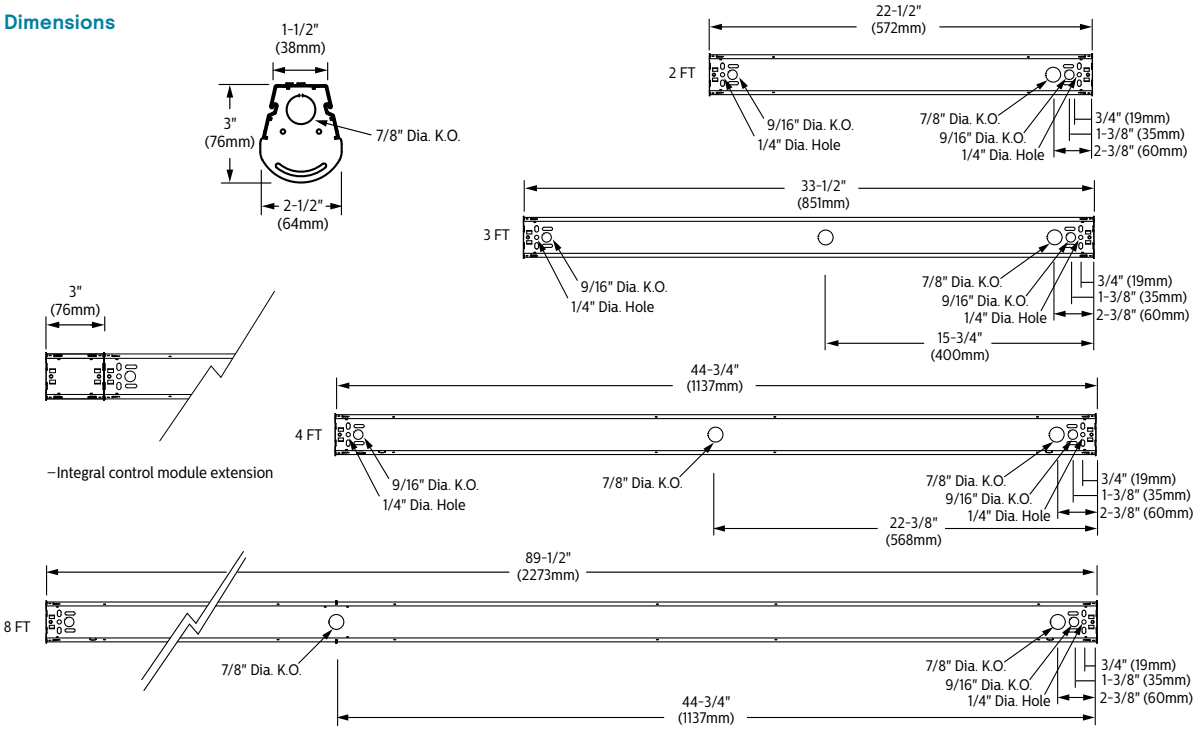
Performance data

Fixture	Lumens	Wattage	Efficacy
FSS220L	2000lm	17W	123lm/w
FSS330L	3000lm	26W	119lm/w
FSS440L	4000lm	31W	133lm/w
FSS455L	5500lm	45W	129lm/w
FSS470L	7000lm	58W	126lm/w

Ambient temperature data

Configuration	Ambient
FSS470L	-20°C to 30°C
FSS8110L	-20°C to 35°C
FSS8140L	-20°C to 25°C
EMLED option	Minimum 0°C
All others	-20°C to 40°C

Dimensions



FSS FluxStream LED strip

2', 3', 4' and 8'

Wireless Controls Options

SpaceWise DT (SWZDT)

- Standalone daylight and occupancy sensing with advanced grouping, wireless mesh networking and dwell time.
- Commissioning via compatible Android phone and Philips Field App
- Dimming via compatible Zigbee wireless wall switch only (see link below for details)
- Register for the commissioning app at http://registration.componentcloud.philips.com/appregistration/
- Integral sensing options may not be combined
- For more information including recommended switches, refer to the following: –

  SWZDT – www.usa.lighting.philips.com/systems/lighting-systems/spacewise

Emergency Options (ER100)

- Power Sensing (Factory default) – Recommended UL924 option requires unswitched power sense line, absence of voltage on the normal circuit triggers luminaire to 100% output
- Power Interruption Detection (Field option) – Detects AC power interruption >30ms triggers 90 minute emergency mode with luminaire at 100% output

FluxStream strip shown with integral sensor

Interact Pro scalable sensor for Foundation, Advanced & Enterprise tiers (SWZCS/SWZCSH and an evolution of SpaceWise)

- SWZCS/SWZCSH is a connected sensor with integral occupancy and daylight sensing and supports wireless mesh connectivity.
- The sensor works in the Foundation mode (similar to SpaceWise) when configured without a gateway or in an Interact Pro Advanced or Enterprise mode if a compatible gateway is used.
- Interact Pro includes an App, a portal and a broad portfolio of wireless luminaires, lamps and retrofit kits all working on the same system.
- Startup is implemented via Interact Pro App (Android or iPhone) & BlueTooth connectivity. The App provides flexibility to choose between a gateway or non gateway mode for setup.
- Setup with the gateway requires wired internet access to the gateway. It is possible to add a gateway at a later point.
- Prepare project configuration steps remotely and use IRT9015 remote onsite to identify and group devices together.
  - Compatible with:
    - UID8451/10 wireless dimmer switch
    - SWS200 wireless scene switch
    - Battery powered IP42 presence sensor OCC sensor IA CM WH 10/1
    - Battery powered IP42 presence & daylight sensor OCC-DL sensor IA CM IP42 WH
    - Battery powered IP65 presence sensor OCC sensor IA CM IP65 WH
    - Battery powered IP65 presence & daylight sensor OCC-DL sensor IA CM IP65 WH
- For more information on Interact Pro visit: www.interact-lighting.com/interactproscalablesystem

Radio only sensor (RADIO)

- Integral RADIO only sensor simply enables wireless mesh connectivity to the luminaire without any occupancy or daylight sensing.
- Ideal for applications where sensing functionality is managed by other Interact devices and the luminaire only needs to have wireless connectivity.

Interact Pro scalable sensor bundles for Enterprise tier

- IAOSB option in addition to occupancy and daylight sensing supports advanced IoT capabilities such as people estimation analysis, desk level temperature & humidity sensing, noise classification, and BLE beacon.
- Compatible with UID8451/10 wireless dimmer switch, SWS200 wireless scene switch, wireless Occ sensor (OCC SENSOR IA CM IP42 WH 10/1) and wireless Day/Occ sensor (OCC MULTI SENSOR IA CM WH 10/1) and wireless Occupancy or Daylight & Occupancy sensors available.
- Use Interact software and insights to increase building efficiency, achieve building wide integration and optimize space through occupancy analytics.
- Requires compatible Gateway and internet connectivity for commissioning.
- For more information, visit: www.interact-lighting.com/office or www.usa.lighting.philips.com/systems/system-areas/offices

Wired Controls Options

Interact PoE

- PoE based IoT connected lighting solution for large enterprises that span across multiple floors, buildings and require multiple gateways.
- Use Interact software and insights to increase building efficiency, achieve building wide integration and optimize space through occupancy analytics.
- IAOSB option in addition to occupancy and daylight sensing supports advanced IoT capabilities such as people estimation analysis, desk level temperature & humidity sensing, noise classification, and BLE beacon.
- PoE lighting controller is accessible from below.
- Integral sensor option for occupancy sensing (PIR) and/or daylight harvesting available for additional energy savings.
- Optional integral emergency controller and battery pack provides 600lm nominal output. Test switch and indicator light mounted on side of chassis on one end.
- Emergency battery has a 3 month pre-installed shelf life, and must be stored and installed in environments of 20C to 30C (-4F to 86F) ambient, and 45-85% relative humidity.
- For more information, visit: www.interact-lighting.com/office or www.usa.lighting.philips.com/systems/system-areas/offices

FSS FluxStream LED strip

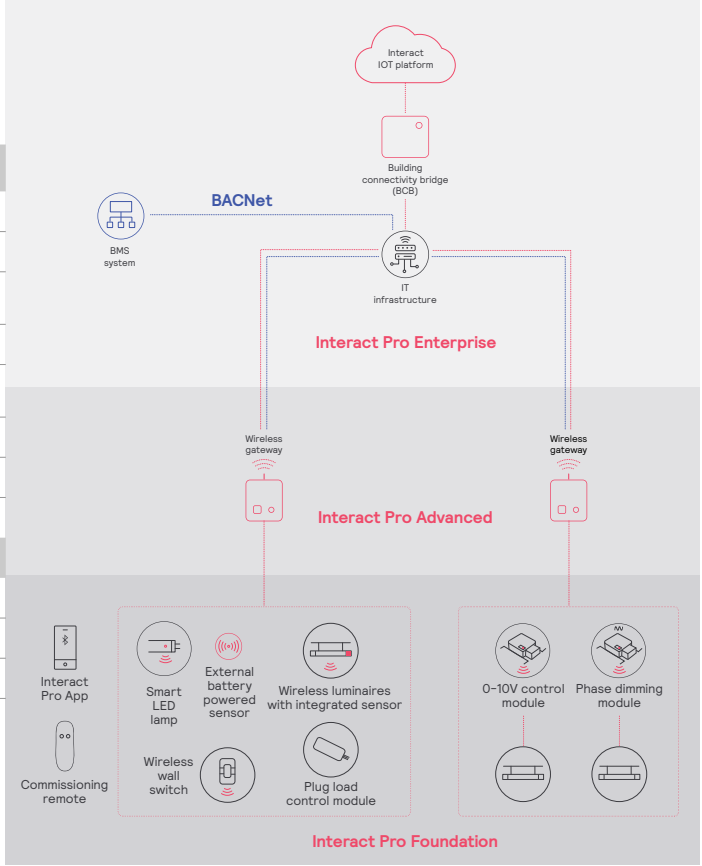
2', 3', 4' and 8'

	Interact Pro scalable system		
			
	Foundation	Advanced	Enterprise
Dimming, grouping, and zoning	✓	✓	✓
Bluetooth and ZigBee enabled	✓	✓	✓
Motion sensing and daylight harvesting	✓	✓	✓
Integration with 0–10V and phase dimming fixtures	✓	✓	✓
Code compliance	✓	✓	✓
Granular dimming and dwell time	✓	✓	✓
Energy reporting and monitoring		✓	✓
Scheduling		✓	✓
Demand response		✓	✓
BMS integration (BACnet)			✓
Floor plan visualization			✓
IoT sensors for wellness			✓
IoT Apps for productivity			✓

Currently supported maximum system size

To be able to design the lighting system correctly for the customer, it is important to know the prime characteristics of the system, its possibilities and limitations.

System level	
Total number of gateways	Unlimited
Total number of devices	200 per network
• luminaires with integrated sensors	150
• smart TLEDS	150
Total number of ZGP devices (sensors and switches)	50
• sensors	30
• switches	50
• zones and groups	64
Group level	
Recommended number of lights	40 (recommended 25)
Number of ZGP devices	5
Number of scenes	16



FSS FluxStream LED strip

2', 3', 4' and 8'

Photometry

2' FluxStream LED strip, 2000 nominal delivered lumens

LER – 123

Catalog No.	FSS220L840-UNV-DIM
Test No.	37164
S/MH	1.2
Lamp Type	LED
Lumens	2034
Input Watts	17

Comparative yearly lighting energy cost per 1000 lumens – **$1.95** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	644	644	644	644
5	635	641	646	641
15	610	618	626	618
25	520	567	585	567
35	451	474	495	474
45	371	403	432	403
55	284	324	362	324
65	191	243	288	243
75	96	167	218	167
85	18	105	155	105

Light Distribution

Degrees	Lumens	% Luminaire
0-30	493	24.2
0-40	790	38.9
0-60	1391	68.4
0-90	1910	93.9
90-180	124	6.1
0-180	2034	100

Average Luminance

Zone	End	45°	Cross
45	15155	12916	12955
55	14048	11583	11859
65	12449	10173	10781
75	9646	8758	9839
85	4206	7611	9181

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)								
pfc =	20							
Ceil	80			70			50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	114	114	114	108	108
1	106	100	94	102	96	93	92	88
2	95	86	79	92	83	77	80	73
3	86	76	67	83	73	66	69	63
4	79	67	57	77	65	56	61	55
5	72	59	50	69	57	50	55	47
6	67	54	45	65	52	44	50	41
7	61	48	40	59	47	39	45	38
8	57	44	35	56	42	34	41	34
9	54	40	32	53	40	32	38	30
10	51	38	30	49	37	29	35	29

3' FluxStream LED strip, 3000 nominal delivered lumens

LER – 119

Catalog No.	FSS330L840-UNV-DIM
Test No.	37132
S/MH	1.3
Lamp Type	LED
Lumens	3045
Input Watts	26

Comparative yearly lighting energy cost per 1000 lumens – **$2.02** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	982	982	982	982
5	966	978	980	978
15	927	943	948	943
25	849	869	884	869
35	738	772	795	772
45	609	655	690	655
55	435	505	554	505
65	293	356	414	356
75	148	232	301	232
85	28	129	201	129

Light Distribution

Degrees	Lumens	% Luminaire
0-30	759	24.9
0-40	1241	40.8
0-60	2187	71.8
0-90	2918	95.8
90-180	127	4.2
0-180	3045	100

Average Luminance

Zone	End	45°	Cross
45	16859	14162	13823
55	14686	12197	12138
65	13174	10098	10376
75	10412	8269	9110
85	4882	6455	7980

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)								
pfc =	20							
Ceil	80			70			50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	109	109
1	107	101	96	103	98	93	93	90
2	96	88	81	93	85	79	81	76
3	88	77	68	84	75	67	70	65
4	80	68	58	78	66	57	63	56
5	73	60	51	70	58	51	56	48
6	68	55	45	66	53	45	51	44
7	63	48	40	60	47	40	46	39
8	58	45	36	56	44	35	42	34
9	55	40	33	53	40	33	39	32
10	51	38	30	50	38	30	36	29

FSS FluxStream LED strip

2', 3', 4' and 8'

Photometry

4' FluxStream LED strip, 4000 nominal delivered lumens — LER – 133

Catalog No. FSS440L840-UNV-DIM
Test No. 37259
S/MH 1.3
Lamp Type LED
Lumens 4130
Input Watts 31

Comparative yearly lighting energy cost per 1000 lumens – **$1.80** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	1272	1272	1272	1272
5	1250	1265	1277	1265
15	1199	1221	1237	1221
25	1098	1130	1157	1130
35	957	1005	1044	1005
45	791	860	910	860
55	606	690	758	690
65	382	481	598	481
75	194	326	416	326
85	36	196	289	196

Light Distribution

Degrees	Lumens	% Luminaire
0-30	986	23.9
0-40	1614	39.1
0-60	2886	69.9
0-90	3905	94.6
90-180	225	5.4
0-180	4130	100

Average Luminance

Zone	End	45°	Cross
45	16754	14171	13847
55	15678	12712	12618
65	13207	10415	11375
75	10615	8873	9550
85	5052	7511	8720

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pfc =	20							
Ceil	80			70			50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	114	114	114	108	108
1	106	101	95	103	97	93	92	89
2	95	86	80	93	84	78	80	75
3	86	76	67	83	73	66	69	64
4	80	67	57	77	65	56	61	55
5	72	59	51	70	57	50	56	47
6	68	54	45	65	53	44	50	42
7	63	48	40	59	47	39	46	38
8	57	44	35	56	44	34	41	34
9	54	40	32	53	40	32	38	30
10	51	38	30	49	37	29	35	28

4' FluxStream LED strip, 5500 nominal delivered lumens — LER – 129

Catalog No. FSS455L840-UNV-DIM
Test No. 37262
S/MH 1.3
Lamp Type LED
Lumens 5759
Input Watts 45

Comparative yearly lighting energy cost per 1000 lumens – **$1.86** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	1788	1788	1788	1788
5	1757	1777	1792	1777
15	1685	1715	1736	1715
25	1544	1585	1623	1585
35	1346	1408	1462	1408
45	1113	1202	1271	1202
55	852	960	1055	960
65	575	712	828	712
75	272	443	610	443
85	50	259	389	259

Light Distribution

Degrees	Lumens	% Luminaire
0-30	1384	24
0-40	2264	39.3
0-60	4043	70.2
0-90	5478	95.1
90-180	281	4.9
0-180	5759	100

Average Luminance

Zone	End	45°	Cross
45	23558	19796	19347
55	22047	17697	17574
65	19887	15425	15749
75	14898	12084	14023
85	7023	9926	11749

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pfc =	20							
Ceil	80			70			50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	115	115	115	108	108
1	106	101	95	103	97	93	93	89
2	95	86	80	93	84	78	80	75
3	86	76	68	83	73	66	69	64
4	80	67	57	77	66	56	61	55
5	72	59	51	70	58	50	56	47
6	68	54	45	65	53	44	50	42
7	63	48	40	60	47	39	46	38
8	57	44	35	56	44	34	41	34
9	54	40	32	53	40	32	38	30
10	51	38	30	49	37	29	36	29

4' FluxStream LED strip, 7000 nominal delivered lumens — LER – 126

Catalog No. FSS470L840-UNV-DIM
Test No. 37265
S/MH 1.3
Lamp Type LED
Lumens 7275
Input Watts 58

Comparative yearly lighting energy cost per 1000 lumens – **$1.90** based on 3000 hrs. and $.08 pwr KWH.

The photometric results were obtained in the Day-Brite laboratory which is NVLAP accredited by the National Institute of Standards and Technology.

Photometric values based on test performed in compliance with LM-79.

Candlepower

Angle	End	45	Cross	Back-45
0	2211	2211	2211	2211
5	2176	2199	2217	2199
15	2088	2124	2148	2124
25	1914	1966	2010	1966
35	1672	1750	1813	1750
45	1379	1502	1580	1502
55	1058	1204	1317	1204
65	714	898	1041	898
75	339	592	776	592
85	63	344	524	344

Light Distribution

Degrees	Lumens	% Luminaire
0-30	1714	23.6
0-40	2809	38.6
0-60	5028	69.1
0-90	6879	94.6
90-180	396	5.4
0-180	7275	100

Average Luminance

Zone	End	45°	Cross
45	29203	24745	24050
55	27371	22192	21938
65	24688	19451	19793
75	18540	16135	17825
85	8824	13174	15831

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE 20 PER (pfc=0.20)

pfc =	20							
Ceil	80			70			50	
Wall	70	50	30	70	50	30	50	30
RCR								
0	118	118	118	114	114	114	108	108
1	106	100	95	103	97	93	92	89
2	95	86	79	92	83	78	80	73
3	86	76	67	83	73	66	69	63
4	79	67	57	77	65	56	61	55
5	72	59	50	69	57	48	55	47
6	67	54	44	65	52	44	50	41
7	61	47	40	59	46	39	45	38
8	57	44	35	56	42	34	40	34
9	54	40	32	52	40	32	38	30
10	51	37	29	49	37	29	35	28

FSS FluxStream LED strip

2', 3', 4' and 8'

Accessories[19]

Accessory Catalog Code	Description	
FSTH	Sliding hanger bracket (pair)	
SV5F12	12" Stem and canopy kit	White stem and canopy kit, 1/4" trade size (1/2" O.D.) locknuts included. Works with 9/16" k.O. on base of housing.
SV5F18	18" Stem and canopy kit	
SV5F24	24" Stem and canopy kit	
SV5F36	36" Stem and canopy kit	
SV5F48	48" Stem and canopy kit	
FKR-126	Chain hanger set (pair)	Includes two 5' heavy duty link chains with "V" hooks. Attaches to base of housing.
DACHxx	Adjustable cable hanger kit (single)	Works with 1/4" hole on base of housing or FSTH hanger bracket. **xx**=cable length in inches, enter 48" to 180" lengths in 12" increments
DACHxx-1-SC	Adjustable cable hanger kit with white straight 18/3 cord (single)	
DACHxx-1-CC	Adjustable cable hanger kit with white coiled 18/3 cord (single)	
DACHxx-2-SC	Adjustable cable hanger kit with white straight 18/4 cord (single)	
DACHxx-2-CC	Adjustable cable hanger kit with white coiled 18/4 cord (single)	
DACHxx-1D-SC	Adjustable cable hanger kit with white straight 18/5 cord with dimming leads (single)	
LSXR10	Low bay pir motion sensor (120-277v)	
LSXR10ADC	Low bay pir motion sensor with photocell and hi/lo trim dimming (120-277v)	
FSSWG4	4' Wire guard (order two for 8' models)	
FSSD2L	2' Diffuse replacement lens	
FSSD3L	3' Diffuse replacement lens	
FSSD4L	4' Diffuse replacement lens (order two for 8' models)	
FSSDEK	Decorative plastic end cap (set of two)	

19 Consult Signify to confirm whether specific accessories are BAA-compliant.

Signify

Signify North America Corporation
200 Franklin Square Drive,
Somerset, NJ 08873
Telephone 855-486-2216

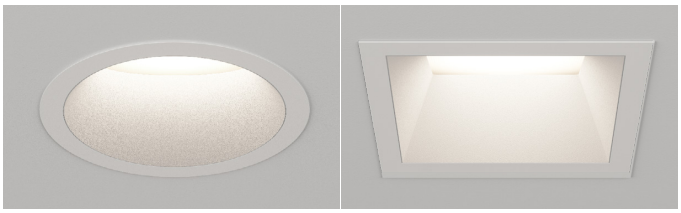
Signify Canada Ltd.
281 Hillmount Road,
Markham, ON, Canada L6C 2S3
Telephone 800-668-9008

NOT USED

FRAXION®3 SLIM WALLWASH

PROJECT NAME:	TYPE:

Lots of light in an under-the-radar profile, with multiple design and installation options, ideal for corporate offices and retail settings.



ORDERING INFORMATION - DOWNLIGHT / HOUSING

JA8-2019 INDICATED BY SHADING

SHAPE	TRIM	RATING	TYPE		FLANGE FINISH	BAFFLE FINISH		LUMEN PACKAGE	CCT		OPTIC	INSTALL TYPE	CEILING THICKNESS		DRIVER
			W	-			-			-	WW			-	
F3R Round F3S Square	M Microflange T Trimless Drywall W Trimless Wood* *(Not available for Wet location)	1 Dry/Damp 2 Wet* *(Requires provided suction cup to service or aim & focus)	W Wallwash		WH White BK Black PR Primer AU Cashmere Gold AG Satin Silver BB Burnt Bronze 00 Trimless* *(Required for trimless) CF Custom Finish* *(Consult Factory)	WH White BK Black PR Primer AU Cashmere Gold AG Satin Silver BB Burnt Bronze CF Custom Finish* *(Consult Factory)		STATIC WHITE 80C12A 80+ CRI Dlvd. Lumens - 679 80C16A 80+ CRI Dlvd. Lumens - 934 80C23A 80+ CRI Dlvd. Lumens - 1286 90C10A 90+ CRI Dlvd. Lumens - 583 90C14A 90+ CRI Dlvd. Lumens - 799 90C19A 90+ CRI Dlvd. Lumens - 1102 97C10A 97+ CRI Dlvd. Lumens - 519 97C12A 97+ CRI Dlvd. Lumens - 711 97C17A 97+ CRI Dlvd. Lumens - 982* *(Not available for IC housings)	22 2200K* *(Only available with 90C10A and 90C14A) 27 2700K 30 3000K 35 3500K 40 4000K		WW Wallwash	INTEGRAL DRIVER X IC Y NIC C IC, Airtight* *(Chicago Plenum, Airtight & Title 24 compliant housing) REMOTE DRIVER V IC, Remote W NIC, Remote D IC, Airtight, Remote* *(Chicago Plenum, Airtight & Title 24 compliant housing)	1 0.50" - 1.375" 2 1.375" - 2.125" T 0.50" - 1.375"* *(Includes adjustable housing height bracket, recommended for any T-Grid or Furring Channel applications)		INTEGRAL PH ELV/Triac, 2% 120V* *(Not available for 80C12A, 90C10A, and 97C10A) SG 0-10V Analog, LOG 1% 120 or 277V SN 0-10V Analog, LIN 1% 120 or 277V LP Lutron, Hi-Lume Premier Ecosystem 0.1% Fade to Black, 120 or 277V* *(Not available for 80C23A, 90C19A, or 97C17A in all IC install types) REMOTE (120V) L2 Lutron, Hi-Lume 1% 2-wire REMOTE (120-277V) EG eldoLED, SOLOdrive 0.1% 0-10V, LOG EN eldoLED, SOLOdrive 0.1% 0-10V, LIN ED eldoLED, SOLOdrive 0.1% DALI, LOG TUNABLE WHITE REMOTE (120-277V) DG eldoLED, DUALdrive 0.1% 0-10V, LOG DN eldoLED, DUALdrive 0.1% 0-10V, LIN DD eldoLED, DUALdrive 0.1% DALI, LOG
								WARM DIM 90W11A 90+ CRI Dlvd. Lumens - 719 Incandescent Profile 90W13A 90+ CRI Dlvd. Lumens - 757 Halogen Profile *SEE PAGE 3 FOR DETAILED WARM DIM PROFILE COMPARISON.	WL 2700K - 1800K WD 3200K - 1800K					
								TUNABLE WHITE 90T12A 90+ CRI Dlvd. Lumens -764* *(Only available for remote housings) *ALL DELIVERED LUMEN OUTPUTS AND T24 COMPLIANCE REFLECT 3000K PAIRED WITH 40° OPTIC AND SOFT FOCUS LENS. REFERENCE PAGE 3 FOR ADDITIONAL T24 COMPLIANT CONFIGURATIONS.	TW 5000K - 2700K					

(WH) White Powder Coat

(BK) Black Powder Coat

(AU) Cashmere Gold Powder Coat

(AG) Satin Silver Powder Coat

(BB) Burnt Bronze Powder Coat

PART NUMBER NOTES

- Housing and trim ship as e.g., F3RM1W-WHWH-90C10A2-3X1-PH*
- Remote driver ships with fixture as e.g., PSF3-RMT-90C-10A-1L2*

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FRAXION3 SLIM WALLWASH

ACCESSORIES

REPLACEMENT OPTIC
Interchangeable optics accessible through fixture aperture.
☐ **RO-50-WW-2** Wallwash optic

REPLACEMENT TUNABLE WHITE OPTIC
Interchangeable optics accessible through fixture aperture.
☐ **RO-50-WW-3** Wallwash optic

ALTERNATE BAFFLE ASSEMBLY (INCLUDES EFFECTS DEVICE)

ASSEMBLY		SHAPE	RATING	TYPE		BAFFLE FINISH
RBA	-			W	-	
REPLACEMENT BAFFLE ASSEMBLY		F3R Round F3S Square	1 Dry / Damp 2 Wet* *(Requires suction cup to service or aim & focus)	W Wallwash		WH White BK Black PR Primer AU Cashmere Gold AG Satin Silver BB Burnt Bronze CF Custom Finish * *(Consult Factory)

T-GRID ACCESSORY KIT
Supplied with ceiling thickness "T" and recommended for installations in T-Grid and furring channel up to 1.5" tall. Available for ceiling thicknesses from 0.50" - 2.125".

☐ **TG-FX3-KIT**

HANGER BAR EXTENDER KIT
Extends hanger bars from 24.0" to 46.0" maximum.
☐ **FRX-HBE-46** Extender, Hanger Bar

EMERGENCY LIGHTING - REMOTE MOUNT ONLY
During disruption of main power, emergency battery inverter provides temporary 120V or 277V to fixture.

☐ **EMB-S-20/25-120/277-LEDX** 20/25 watt max capacity, 120 or 277 VAC 60Hz, Non-Dimmable
☐ **EMB-S-100-120-LEDX** 100 watt max capacity, 120 VAC 60Hz, Dimmable
☐ **EMB-S-100-277-LEDX** 100 watt max capacity, 277 VAC 60Hz, Dimmable
☐ **EMB-S-250-120/277-LEDX** 250 watt max capacity, 120 or 277 VAC 60Hz, Dimmable

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FRAXION3 SLIM WALLWASH

PERFORMANCE - 3000K

LUMEN PACKAGE	WATTAGE	WALLWASH OPTIC	
		DELIVERED	LPW
80C12A	10	679	67
80C16A	14	934	66
80C23A	21	1286	61
90C10A	10	583	58
90C14A	14	799	57
90C19A	21	1102	52
97C10A	10	519	51
97C12A	14	711	50
97C17A	21	982	46
90W11A	14	719	51
90W13A	14	757	54
90T12A	16	764	48

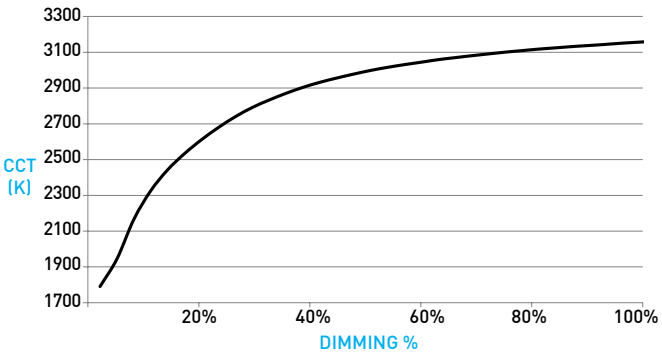
JA8-2019 INDICATED BY SHADING

OUTPUT MULTIPLIER	
CCT	CCT SCALE
2200K (Consult factory for JA8 details)	0.800
2700K	0.957
3000K	1.000
3500K	1.019
4000K	1.030

WARM DIM PERFORMANCE

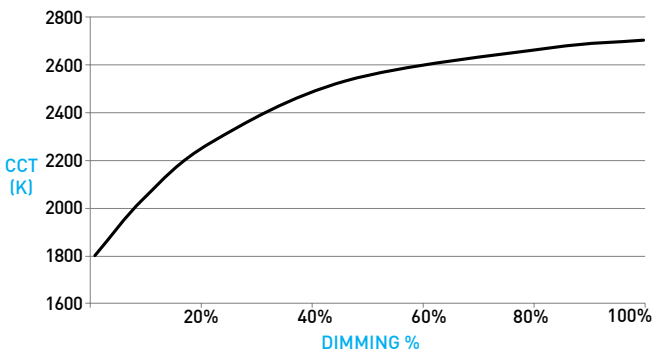
WARM DIM TO MIRROR HALOGEN DIMMING PROFILE

90W13A 3200K - 1800K	Full on 100%	Dimmed to 80%	Dimmed to 70%	Dimmed to 50%	Dimmed to 20%	Dimmed to 10%	Dimmed to 2%
CCT (K)	3200	3150	3100	3000	2700	2200	1800
Light Output (Lm)	757	606	495	353	151	76	15
Power (W)	14	11	10	7	3	1.5	0.3
Efficacy (LPW)	54	54	54	54	54	54	54



WARM DIM TO MIRROR INCANDESCENT DIMMING PROFILE

90W11A 2700K - 1800K	Full on 100%	Dimmed to 80%	Dimmed to 70%	Dimmed to 50%	Dimmed to 20%	Dimmed to 10%	Dimmed to 2%
CCT (K)	2700	2650	2620	2520	2180	1950	1800
Light Output (Lm)	719	575	503	359	144	72	14
Power (W)	14	11	10	7	3	1.5	0.3
Efficacy (LPW)	51	51	51	51	51	51	51



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FRAXION3 SLIM WALLWASH

DOWNLIGHT / HOUSING

A LED
Integral LED module design enables field service / replacement through housing aperture.

B OPTIC
Proprietary wallwash optic integrates Reflection, Refraction and TIR principles.

C TRIMLESS WOOD SPACERS
Provided for Trimless Wood installations; includes (1) 1/16" spacer and (5) 1/8" spacers.

D TRIM EXTENSION
Provided for -2 ceiling thickness; accommodates 2.125" max ceiling thickness.

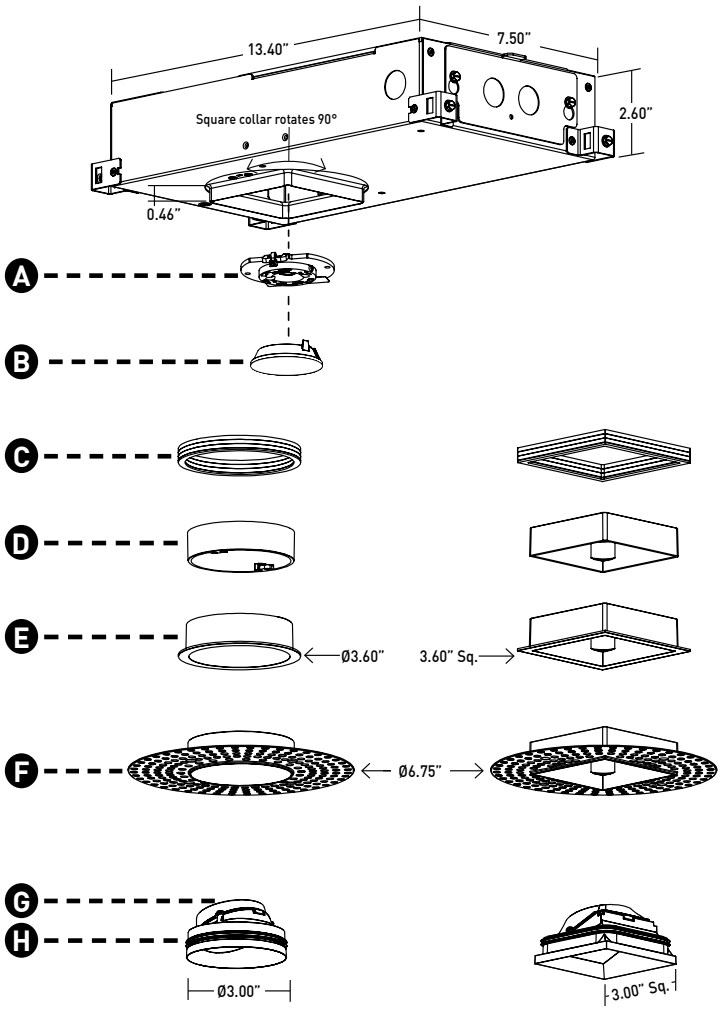
E MICROFLANGE PROFILE
Features 0.30" flange. Thickness measures 0.06". Installed after ceiling is complete. Requires 3.375" diameter cutout. Wet location features integral silicone gasket.

F TRIMLESS DRYWALL PROFILE
Installs totally flush with the ceiling with no visible trim. Appliqué includes screws for mounting and has 0.06" plaster stop. Not recommended for stucco applications.

G EFFECTS DEVICES
Asymmetrical spread lens, included and sealed in place, combined with angled optic and wide aperture enhance uniformity. Suction tool provided for removal of baffle.

H BAFFLE
Die-cast baffle minimizes aperture glare and conceals view into housing; includes gasket.

DIMENSIONS / DRAWINGS



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FRAXION3 SLIM WALLWASH

DOWNLIGHT / HOUSING

I **IC HOUSING**
- For IC ceilings.
- No setback from polycell spray foam insulation having max R-Value of 60 on all sides and top of housing.

J **NIC HOUSING**
- Minimum 0.50" setback from combustible and non-combustible materials on all sides and top of housing.
- Minimum 3.00" setback from insulation material having max R-Value 30 on all sides and top of housing.
- Minimum 6.00" setback from polycell spray foam insulation having max R-Value 60.

K **ADJUSTABLE HANGER BAR HEIGHT ACCESSORY**
Provided with ceiling thickness "T" and recommended for installations in T-Grid and furring channel up to 1.5" tall. Hanger bars are installed to adjustable bracket. Allows housing to be raised and lowered; ceiling thickness remains 0.5" to 1.375" max.

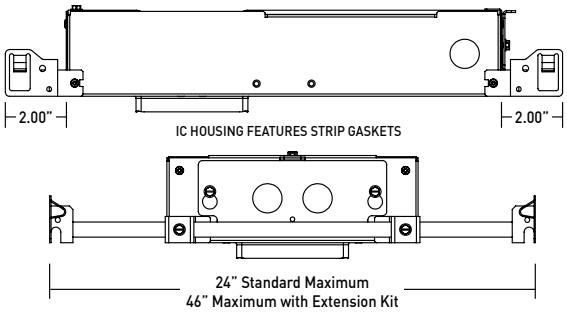
L **APPLIQUÉ DETAIL**
Appliqué for plaster floating directly to baffle.

M **REMOTE POWER SUPPLY**
Provided with install Types "V", "W" and "D". Remote power supply provides additional driver options. Consult installation guide for maximum allowable secondary run lengths between PSF3-RMT and fixture. Must be installed in an accessible location.

HOUSING NOTES

- Do not install in environments where ambient temperatures exceed 25°C (77°F).
- Power supply compartment and all splice connections may be serviced from room side.
- Consult factory for spacing requirements for any installations exceeding R-Value 60.
- Hanger bars fitted to short side of housing or long side when TG accessory is specified; extend from 14.0" to 24.0", but may be field cut to accommodate narrow stud spacing. Can be extended up to 46" maximum with FRX-HBE-46 kit.
- Hanger bars and brackets add 4.00" max to the overall dimension, but are exclusive of the setback requirements.
- Housings for round trims feature a round aperture housing collar. Housings for square trims feature a square housing collar that rotates up to 90 degrees for fixture alignment. Housing collars accommodate ceiling thicknesses between 0.50" and 2.125".

I / J



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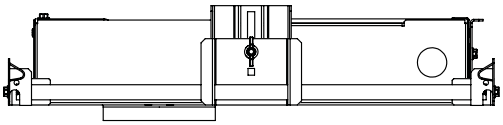

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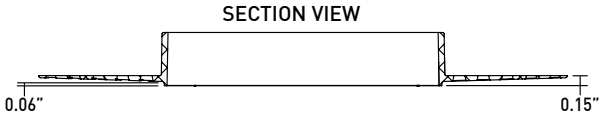

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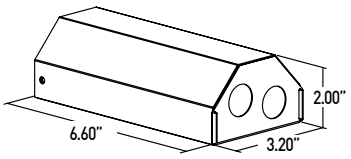

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FRAXION3 SLIM WALLWASH

TECHNICAL

CONSTRUCTION
Downlight: Painted finishes are granulated powder coat.
Housing: Aluminum and 22 Gauge galvanized steel. Extruded aluminum housing panel to act as heat-sink.
Remote Power Supply: 22 Gauge galvanized steel.
Appliqué: Zinc alloy.

STATIC WHITE LED
2-step MacAdam ellipse LED module available in 80+, 90+ and 97+ CRI configurations in color temperatures of 2200K, 2700K, 3000K, 3500K and 4000K. Average rated lamp life of 50,000 hours. LED and driver assemblies are field-replaceable.

WARM DIM LED
3-step MacAdam ellipse warm dim LED module available in 90+ CRI configuration. 3200K or 2700K at full brightness, warming to 1800K at full dim. Average rated lamp life of 50,000 hours. LED and driver assemblies are field-replaceable.

TUNABLE WHITE LED
5-step MacAdam ellipse tunable white LED module available in 90+ CRI configuration. Features tuning range of 2700K to 5000K. Average rated lamp life of 50,000 hours. LED and driver assemblies are field-replaceable.

POWER SUPPLY PERFORMANCE AND DIMMING INFORMATION

Power Supply	PH	SG	SN	LP	L2	EG	EN	ED	DG	DN	DD
Minimum °C	-20 °C	-10 °C	-10 °C	0 °C	0 °C	-20 °C	-20 °C	-20 °C	-20 °C	-20 °C	-20 °C
Maximum °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C
Dimming %	2.0%	1.0%	1.0%	0.1%	1.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

Note: For L2, LP, EG and EN drivers consult chart on page 7 to confirm appropriate dimming curve for compatibility with selected control.

SPACING
Recommended fixture spacing is 36" on center with 36" setback from wall plane.

LISTING
cTUVus listed to UL1598 standard for Dry / Damp and Wet locations. Chicago Plenum, Airtight and Title 24 JA8-2019 Listed.

WARRANTY
Manufacturer's 1-year warranty guarantees product(s) listed to be free from defects in material and workmanship under normal use and service. 5-year warranty on LED and power supply to operate with 70% of the original flux and remain within a range of 3 duv. 10-year Lutron Advantage limited warranty available on Lutron equipped systems. Warranty period begins from the date of shipment by Seller and conditional upon the use of manufacturer-supplied power supply. Consult website for full warranty terms and conditions.

CHANGE LOG
1. 01/12/2021: ADDED 2200K AND 2700K-1800K WARM DIM OFFERINGS.
2. 04/30/2021: REMOVED QUICK SHIP.

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FRAXION3 SLIM WALLWASH

DIMMING COMPATIBILITY

LUTRON DRIVER COMPATIBILITY

Power supply **L2** **Lutron Product Family**	**Part No.**
Maestro WirelessR 600 W dimmer	MRF2-6ND-120-
Maestro WirelessR 1000 W dimmer	MRF2-10ND-120-
Caséta® Wireless Pro 1000 W dimmer	PD-10NXD-
GRAFIK T™ CL® dimmer	GT-250M- GTJ-250M-
HomeWorks® QS adaptive dimmer	HQRD-6NA-
HomeWorks® QS 600 W dimmer	HQRD-6ND-
HomeWorks® QS 1000 W dimmer	HQRD-10ND-
RadioRA® 2 adaptive dimmer	RRD-6NA-
RadioRA® 2 1000 W dimmer	RRD-10ND
myRoom™ DIN power module	MQSE-4A1-D
HomeWorks® QS DIN power module	LQSE-4A1-D
HomeWorks® QS wallbox power module	HQRJ-WPM-6D-120
HomeWorks® wallbox power module	HWI-WPM-6D-120
GRAFIK Eye® QS control unit	QSGR-, QSGRJ-
GRAFIK Eye® 3000 control unit	GRX-3100- GRX-3500-
RPM-4U module (LCP, HomeWorks® QS, GRAFIK Systems™, Quantum®)	HW-RPM-4U-120 LP-RPM-4U-120
RPM-4A module (LCP, HomeWorks® QS, GRAFIK Systems™, Quantum®)	HW-RPM-4A-120, LP-RPM-4A-120
GP dimming panels	Various
Ariadni CL 250W dimmer	AYCL-253P-
Diva CL 250W dimmer	DVCL-253P- DCSCCL-253P-
Nova T CL 250W dimmer	NTCL-250-
Power supply **LP** **Lutron Product Family**	**Part No.**
PowPak Dimming Modules	RMJ-ECO32-DV-B
PowPak Dimming Modules	FCJ/FCJS-ECO
Energi Savr Nodes	QSN-1ECO-S
GRAFIK Eye QS control unit Homeworks QS control unit	QSN-2ECO-S
GRAFIK Eye QS control unit Homeworks QS control unit	QSGRJ-_E (wireless) QSGR-_E
Quantum Hub	QP2-_ _ 2C
Quantum Hub	QP2-_ _ 4C
Quantum Hub	QP2-_ _ 6C
Quantum Hub	QP2-_ _ 8C
Homeworks QS power module myRoom Plus power module	LQSE-2ECO-D

LUTRON
2016 OEM
ADVANTAGE
ACCOUNT

eldoLED DRIVER COMPATIBILITY

Power supply **EG / EN** **Dimmer / Switch Control Manufacturer**	**Family/Model #**
Busch-Jaeger	2112U-101
Jung	240-10
Leviton Lighting Controls	IP710-DLX
Lightolier Controls	ZP600FAM120
Lutron Electronics	Nova T® - NTFTV
Lutron Electronics	Diva® - DVTV
Lutron Electronics	Nova® - NFTV
Merten	5729
Pass & Seymour	CD4FB-W
The Watt Stopper	DCLV1
Sensor Switch	nIO EZ
Synergy	ISD BC
Power supply **EG / EN** **Lighting Control System Manufacturer**	**Family/Model #**
Lutron Electronics	GrafixEye® GRX-TVI w GRX3503
Lutron Electronics	Energy Savr Node™ - QSN-4T16-S
Lutron Electronics	TVM2 Module
Crestron®	GLX-DIMFLV8
Crestron®	GLXP-DIMFLV8
Crestron®	GLPAC-DIMFLV4-*
Crestron®	GLPAC-DIMFLV8-*
Crestron®	GLPP-DIMFLVEX-PM
Crestron®	GLPP-1DIMFLV2EX-PM
Crestron®	GLPP-1DIMFLV3EX-PM
Crestron®	DIN-AO8
Crestron®	DIN-4DIMFLV4
Crestron®	CLS-EXP-DIMFLV
Crestron®	CLCI-1DIMFLV2EX
ABB	SD/S 2.16.1

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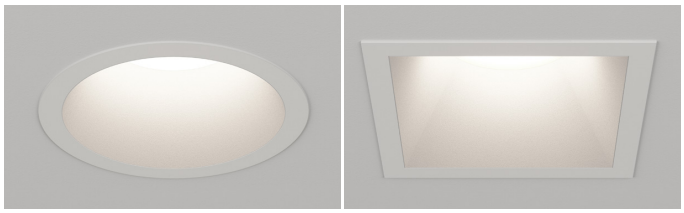
FRAXION®3 SLIM

FIXED

PROJECT NAME:	TYPE:



Lots of light in an under-the-radar profile, with multiple design and installation options, ideal for corporate offices and retail settings.

ORDERING INFORMATION - DOWNLIGHT / HOUSING

JA8-2019 INDICATED BY SHADING

SHAPE	TRIM	RATING	TYPE		FLANGE FINISH	BAFFLE FINISH		LUMEN PACKAGE	CCT	OPTIC	INSTALL TYPE	CEILING THICKNESS		DRIVER	EFFECTS DEVICE
			F	-			-						-		
F3R Round F3S Square	M Microflange T Trimless Drywall W Trimless Wood* *(Not available for Wet location)	1 Dry/Damp 2 Wet* *(Requires provided suction cup to service or aim & focus)	F Fixed		WH White BK Black PR Primer AU Cashmere Gold AG Satin Silver BB Burnt Bronze 00 Trimless* *(Required for trimless) CF Custom Finish* *(Consult Factory)	WH White BK Black PR Primer AU Cashmere Gold AG Satin Silver BB Burnt Bronze CF Custom Finish* *(Consult Factory)		STATIC WHITE 80C12A 80+ CRI Dlvd. Lumens - 795 80C16A 80+ CRI Dlvd. Lumens - 1095 80C23A 80+ CRI Dlvd. Lumens - 1506 90C10A 90+ CRI Dlvd. Lumens - 683 90C14A 90+ CRI Dlvd. Lumens - 936 90C19A 90+ CRI Dlvd. Lumens - 1291 97C10A 97+ CRI Dlvd. Lumens - 608 97C12A 97+ CRI Dlvd. Lumens - 833 97C17A 97+ CRI Dlvd. Lumens - 1151* *(Not available for IC housings) WARM DIM 90W11A 90+ CRI Dlvd. Lumens - 857 Incandescent Profile 90W13A 90+ CRI Dlvd. Lumens - 902 Halogen Profile *SEE PAGE 3 FOR DETAILED WARM DIM PROFILE COMPARISON. TUNABLE WHITE 90T12A 90+ CRI Dlvd. Lumens -950* *(Only available for remote housings) *ALL DELIVERED LUMEN OUTPUTS AND T24 COMPLIANCE REFLECT 3000K PAIRED WITH 40° OPTIC AND SOFT FOCUS LENS. REFERENCE PAGE 3 FOR ADDITIONAL T24 COMPLIANT CONFIGURATIONS.	22 2200K* *(Only available with 90C10A and 90C14A) 27 2700K 30 3000K 35 3500K 40 4000K WL 2700K - 1800K WD 3200K - 1800K TW 5000K - 2700K	10 10°* *(Only available with 80C12A, 90C10A and 97C10A. Not available with 2200K) 15 15° 22 22° 40 40° 60 60° 85 85°* *(Uses 60° optic and optional configuration 14 (WDL) to achieve 85° beam spread) 15 15° 22 22° 40 40° 60 60° 85 85°* *(Uses 60° optic and optional configuration 14 (WDL) to achieve 85° beam spread) 22 22° 40 40° 60 60° 85 85°* *(Uses 60° optic and optional configuration 14 (WDL) to achieve 85° beam spread)	INTEGRAL DRIVER X IC Y NIC C IC, Airtight* *(Chicago Plenum, Airtight & Title 24 compliant housing) REMOTE DRIVER V IC, Remote W NIC, Remote D IC, Airtight, Remote* *(Chicago Plenum, Airtight & Title 24 compliant housing)	1 0.50" - 1.375" 2 1.375" - 2.125" T 0.50" - 1.375"* *(Includes adjustable housing height bracket, recommended for any T-Grid or Furring Channel applications)	INTEGRAL PH ELV/Triac, 2% 120V* *(Not available for 80C12A, 90C10A, and 97C10A unless 10° degree optic is specified) SG 0-10V Analog, LOG 1% 120 or 277V SN 0-10V Analog, LIN 1% 120 or 277V LP Lutron, Hi-Lume Premier Ecosystem 0.1% Fade to Black, 120 or 277V* *(Not available for 80C23A, 90C19A, or 97C17A in all IC install types) REMOTE (120V) L2 Lutron, Hi-Lume 1% 2-wire REMOTE (120-277V) EG eldoLED, SOLOdrive 0.1% 0-10V, LOG EN eldoLED, SOLOdrive 0.1% 0-10V, LIN ED eldoLED, SOLOdrive 0.1% DALI, LOG TUNABLE WHITE REMOTE (120-277V) DG eldoLED, DUALdrive 0.1% 0-10V, LOG DN eldoLED, DUALdrive 0.1% 0-10V, LIN DD eldoLED, DUALdrive 0.1% DALI, LOG	STANDARD EFFECTS DEVICE 04 Soft Focus Lens NL No Lens* *(Standard and only available with 10° optic. Not available for Wet Location or Airtight Housings) ALTERNATE EFFECTS DEVICE 02 Honeycomb Louver* *(Not available for Wet location, Warm Dim or Airtight Housings) 03 Clear Glass Lens* *(Not available for Warm Dim) 05 Frosted Glass Lens 08 Frosted Soft Focus Lens 14 Wide Distribution Lens* *(Required and only available for 85° beam spread) 26 Frosted Linear Spread Lens

(WH) White Powder Coat

(BK) Black Powder Coat

(AU) Cashmere Gold Powder Coat

(AG) Satin Silver Powder Coat

(BB) Burnt Bronze Powder Coat

PART NUMBER NOTES

- Housing and trim ship as e.g., F3RM1F-WHWH-90C10A2-3X1-PH*
- Remote driver ships with fixture as e.g., PSF3-RMT-90C-10A-1L2*

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FRAXION3 SLIM FIXED

ACCESSORIES

ROUND ALTERNATE EFFECTS DEVICES
Dry / Damp location only
Wet location requires alternate baffle.

- ☐ **HCL-F3R** Honeycomb Louver w/ Diffusion Lens*
  *(Not available for Warm Dim, Wet locations, or Airtight Housings)
- ☐ **CGL-F3R** Clear Glass Lens*
  *(Not available for Warm Dim)
- ☐ **FGL-F3R** Frosted Glass Lens
- ☐ **SFL-F3R** Soft Focus Lens
- ☐ **FSFL-F3R** Frosted Soft Focus Lens
- ☐ **WDL-F3R** Wide Distribution Lens*
  *(For use with 60° optic only)
- ☐ **FLSL-F3R** Frosted Linear Spread Lens

SQUARE ALTERNATE EFFECTS DEVICES
Dry / Damp location only
Wet location requires alternate baffle.

- ☐ **HCL-F3S** Honeycomb Louver w/ Diffusion Lens*
  *(Not available for Warm Dim, Wet locations, or Airtight Housings)
- ☐ **CGL-F3S** Clear Glass Lens*
  *(Not available for Warm Dim)
- ☐ **FGL-F3S** Frosted Glass Lens
- ☐ **SFL-F3S** Soft Focus Lens
- ☐ **FSFL-F3S** Frosted Soft Focus Lens
- ☐ **WDL-F3S** Wide Distribution Lens*
  *(For use with 60° optic only)
- ☐ **FLSL-F3S** Frosted Linear Spread Lens

REPLACEMENT OPTICS
Interchangeable optics accessible through fixture aperture.

- ☐ **RO-50-15-2** 15° optic
- ☐ **RO-50-22-2** 22° optic
- ☐ **RO-50-40-2** 40° optic
- ☐ **RO-50-60-2** 60° optic

REPLACEMENT TUNABLE WHITE OPTICS
Interchangeable optics accessible through fixture aperture.

- ☐ **RO-50-22-3** 22° optic
- ☐ **RO-50-40-3** 40° optic
- ☐ **RO-50-60-3** 60° optic

ALTERNATE BAFFLE ASSEMBLY (INCLUDES EFFECTS DEVICE)

ASSEMBLY		SHAPE	RATING	TYPE		BAFFLE FINISH		EFFECTS DEVICE
RBA	-			F	-		-	
REPLACEMENT BAFFLE ASSEMBLY		F3R Round F3S Square	1 Dry / Damp 2 Wet* *(Requires suction cup to service or aim & focus)	F Fixed		WH White BK Black PR Primer AU Cashmere Gold AG Satin Silver BB Burnt Bronze CF Custom Finish * *(Consult Factory)		Leave blank for standard Soft Focus Lens CGL Clear Glass Lens * *(Not available for Warm Dim) FGL Frosted Glass Lens FSFL Frosted Soft Focus Lens WDL Wide Distribution Lens * *(For use with 60° optic only) FLSL Frosted Linear Spread Lens

REPLACEMENT SUCTION TOOL
One included with every six fixtures designated Wet location.

- ☐ **F4-TOOL-SUCTION** Allows for removal of Wet Location baffles

T-GRID ACCESSORY KIT
Supplied with ceiling thickness "T" and recommended for installations in T-Grid and furring channel up to 1.5" tall. Available for ceiling thicknesses from 0.50" - 2.125".

- ☐ **TG-FX3-KIT**

HANGER BAR EXTENDER KIT
Extends hanger bars from 24.0" to 46.0" maximum.

- ☐ **FRX-HBE-46** Extender, Hanger Bar

EMERGENCY LIGHTING - REMOTE MOUNT ONLY
During disruption of main power, emergency battery inverter provides temporary 120V or 277V to fixture.

- ☐ **EMB-S-20/25-120/277-LEDX** 20/25 watt max capacity, 120 or 277 VAC 60Hz, Non-Dimmable
- ☐ **EMB-S-100-120-LEDX** 100 watt max capacity, 120 VAC 60Hz, Dimmable
- ☐ **EMB-S-100-277-LEDX** 100 watt max capacity, 277 VAC 60Hz, Dimmable
- ☐ **EMB-S-250-120/277-LEDX** 250 watt max capacity, 120 or 277 VAC 60Hz, Dimmable

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FRAXION3 SLIM FIXED

PERFORMANCE - 3000K

LUMEN PACKAGE	WATTAGE	10° OPTIC NO SOFT FOCUS LENS		15° OPTIC SOFT FOCUS LENS		22° OPTIC SOFT FOCUS LENS		40° OPTIC SOFT FOCUS LENS		60° OPTIC SOFT FOCUS LENS		85° OPTIC WIDE DISTRIBUTION LENS	
		DELIVERED	LPW	DELIVERED	LPW	DELIVERED	LPW	DELIVERED	LPW	DELIVERED	LPW	DELIVERED	LPW
80C12A	10	739	51 (14W)	872	86	729	72	795	79	784	78	623	62
80C16A	14	-	-	1191	82	1003	71	1095	78	1079	77	857	61
80C23A	21	-	-	1642	77	1381	65	1506	71	1486	70	1180	56
90C10A	10	627	44 (14W)	721	71	626	62	683	68	673	67	535	53
90C14A	14	-	-	984	68	858	61	936	66	923	65	733	52
90C19A	21	-	-	1357	63	1184	56	1291	61	1273	60	1011	48
97C10A	10	578	40 (14W)	657	65	557	55	608	60	599	59	476	47
97C12A	14	-	-	897	62	763	54	833	59	821	58	652	46
97C17A	21	-	-	1238	58	1055	50	1151	58	1135	54	901	42
90W11A	14	-	-	793	57	690	49	857	61	814	58	719	51
90W13A	14	-	-	835	60	726	51	902	64	857	61	757	54
90T12A	16	-	-	-	-	852	53	950	59	949	59	838	52

JA8-2019 INDICATED BY SHADING

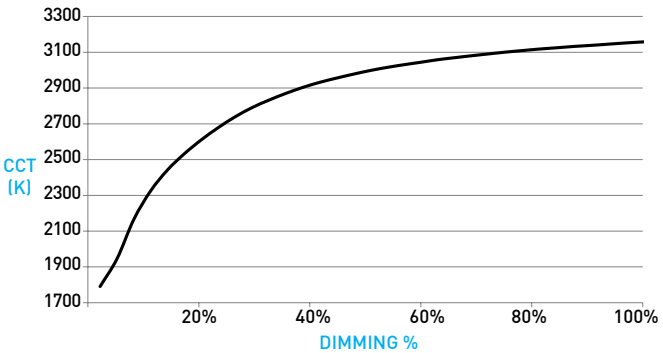
OUTPUT MULTIPLIER	
CCT	CCT SCALE
2200K (Consult factory for JA8 details)	0.800
2700K	0.957
3000K	1.000
3500K	1.019
4000K	1.030

LIGHT LOSS FACTOR MULTIPLIER	
CGL	1.05
SFL	1.00
FGL	0.90
FSFL	0.87
FLSL	0.83
WDL	0.78

WARM DIM PERFORMANCE - SOFT FOCUS LENS - 40° OPTIC

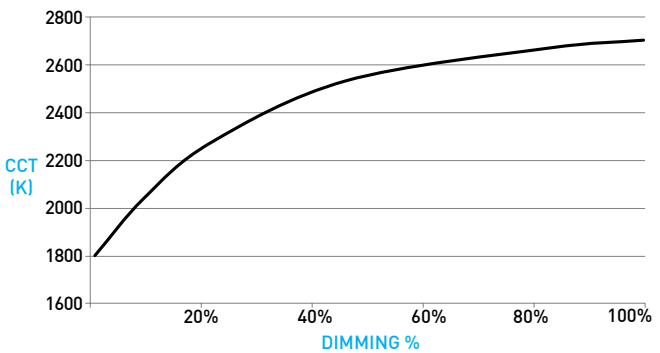
WARM DIM TO MIRROR HALOGEN DIMMING PROFILE

90W13A 3200K - 1800K	Full on 100%	Dimmed to 80%	Dimmed to 70%	Dimmed to 50%	Dimmed to 20%	Dimmed to 10%	Dimmed to 2%
CCT (K)	3200	3150	3100	3000	2700	2200	1800
Light Output (Lm)	902	722	631	451	180	90	18
Power (W)	14	11	10	7	3	1.5	0.3
Efficacy (LPW)	64	64	64	64	64	64	64



WARM DIM TO MIRROR INCANDESCENT DIMMING PROFILE

90W11A 2700K - 1800K	Full on 100%	Dimmed to 80%	Dimmed to 70%	Dimmed to 50%	Dimmed to 20%	Dimmed to 10%	Dimmed to 2%
CCT (K)	2700	2650	2620	2520	2180	1950	1800
Light Output (Lm)	857	686	600	428	171	86	17
Power (W)	14	11	10	7	3	1.5	0.5
Efficacy (LPW)	61	61	61	61	61	61	61



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FRAXION3 SLIM FIXED

DOWNLIGHT / HOUSING

A LED
Integral LED module design enables field service / replacement through housing aperture.

B OPTIC
Proprietary optic integrates Reflection, Refraction and TIR offering 10°, 15°, 22°, 40° & 60° beams.

C TRIMLESS WOOD SPACERS
Provided for Trimless Wood installations; includes (1) 1/16" spacer and (5) 1/8" spacers.

D TRIM EXTENSION
Provided for -2 ceiling thickness; accommodates 2.125" max ceiling thickness.

E MICROFLANGE PROFILE
Features 0.30" flange. Thickness measures 0.06". Installed after ceiling is complete. Requires 3.375" diameter cutout. Wet location features integral silicone gasket.

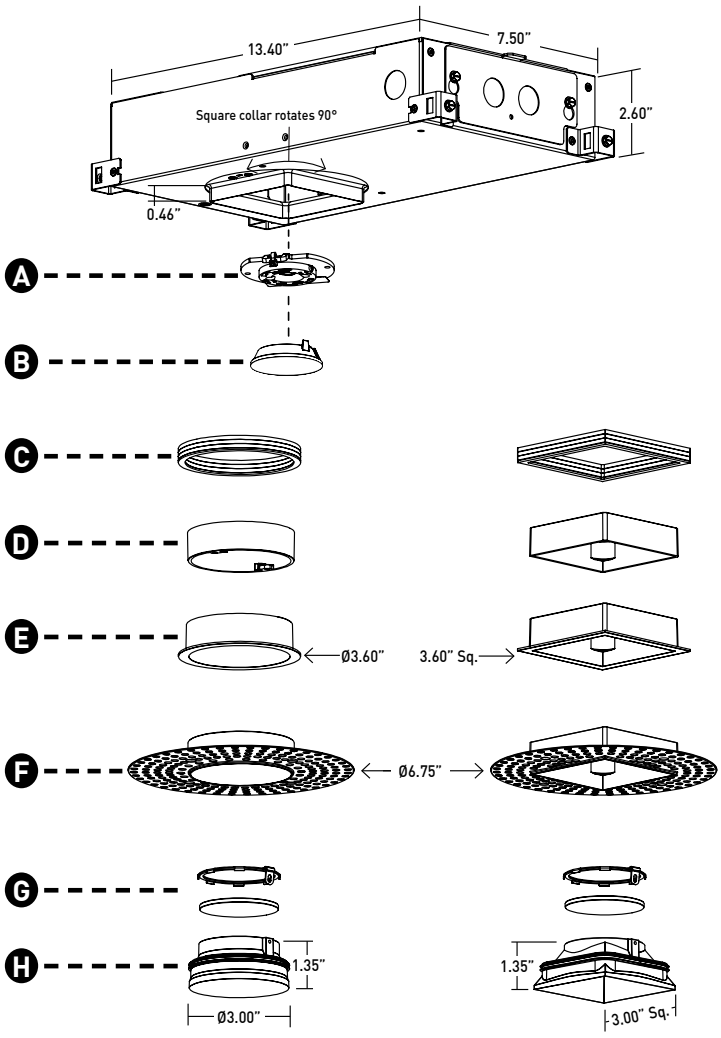
F TRIMLESS DRYWALL PROFILE
Installs totally flush with the ceiling with no visible trim. Appliqué includes screws for mounting and has 0.06" plaster stop. Not recommended for stucco applications.

G EFFECTS DEVICES / LENS RETAINER
Fixture is limited to 1 effects device. Wet location effects device is sealed in place. Suction tool provided for removal of baffle with wet location. Lens retainer allows effects devices to be changed in Dry /Damp locations.

H ROUND BAFFLE
Die-cast removable baffle provides easy access to tilting mechanism and features 62° glare cutoff. Minimizes aperture glare and conceals view into housing; includes gasket.

SQUARE TRANSITIONAL BAFFLE
Die-cast removable baffle provides easy access to tilting mechanism and features 62° glare cutoff. Transitions from square aperture at ceiling plane to round aperture at light source. Minimizes aperture glare and conceals view into housing; includes gasket.

DIMENSIONS / DRAWINGS



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DOWNLIGHT / HOUSING

I **IC HOUSING**
- For IC ceilings.
- No setback from polycell spray foam insulation having max R-Value of 60 on all sides and top of housing.

J **NIC HOUSING**
- Minimum 0.50" setback from combustible and non-combustible materials on all sides and top of housing.
- Minimum 3.00" setback from insulation material having max R-Value 30 on all sides and top of housing.
- Minimum 6.00" setback from polycell spray foam insulation having max R-Value 60.

K **ADJUSTABLE HANGER BAR HEIGHT ACCESSORY**
Provided with ceiling thickness "T" and recommended for installations in T-Grid and furring channel up to 1.5" tall. Hanger bars are installed to adjustable bracket. Allows housing to be raised and lowered; ceiling thickness remains 0.5" to 1.375" max.

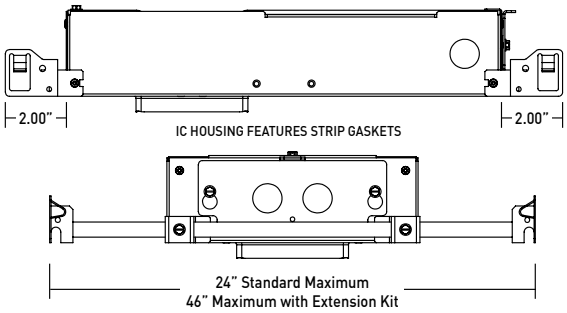
L **APPLIQUÉ DETAIL**
Appliqué for plaster floating directly to baffle.

M **REMOTE POWER SUPPLY**
Provided with install Types "V", "W" and "D". Remote power supply provides additional driver options. Consult installation guide for maximum allowable secondary run lengths between PSF3-RMT and fixture. Must be installed in an accessible location.

HOUSING NOTES

- Do not install in environments where ambient temperatures exceed 25°C (77°F).
- Power supply compartment and all splice connections may be serviced from room side.
- Consult factory for spacing requirements for any installations exceeding R-Value 60.
- Hanger bars fitted to short side of housing or long side when TG accessory is specified; extend from 14.0" to 24.0", but may be field cut to accommodate narrow stud spacing. Can be extended up to 46" maximum with FRX-HBE-46 kit.
- Hanger bars and brackets add 4.00" max to the overall dimension, but are exclusive of the setback requirements.
- Housings for round trims feature a round aperture housing collar. Housings for square trims feature a square housing collar that rotates up to 90 degrees for fixture alignment. Housing collars accommodate ceiling thicknesses between 0.50" and 2.125".

I / J



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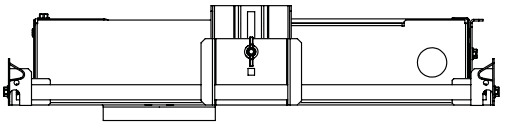

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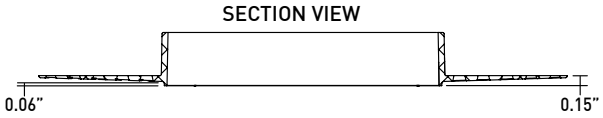

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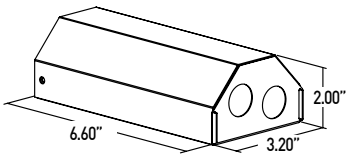

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FRAXION3 SLIM FIXED

TECHNICAL

CONSTRUCTION
Downlight: Painted finishes are granulated powder coat.
Housing: Aluminum and 22 Gauge galvanized steel. Extruded aluminum housing panel to act as heat-sink.
Remote Power Supply: 22 Gauge galvanized steel.
Appliqué: Zinc alloy.

STATIC WHITE LED
2-step MacAdam ellipse LED module available in 80+, 90+ and 97+ CRI configurations in color temperatures of 2200K, 2700K, 3000K, 3500K and 4000K. Average rated lamp life of 50,000 hours. LED and driver assemblies are field-replaceable.

WARM DIM LED
3-step MacAdam ellipse warm dim LED module available in 90+ CRI configuration. 3200K or 2700K at full brightness, warming to 1800K at full dim. Average rated lamp life of 50,000 hours. LED and driver assemblies are field-replaceable.

TUNABLE WHITE LED
5-step MacAdam ellipse tunable white LED module available in 90+ CRI configuration. Features tuning range of 2700K to 5000K. Average rated lamp life of 50,000 hours. LED and driver assemblies are field-replaceable.

POWER SUPPLY PERFORMANCE AND DIMMING INFORMATION

Power Supply	PH	SG	SN	LP	L2	EG	EN	ED	DG	DN	DD
Minimum °C	-20 °C	-10 °C	-10 °C	0 °C	0 °C	-20 °C	-20 °C	-20 °C	-20 °C	-20 °C	-20 °C
Maximum °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C	40 °C
Dimming %	2.0%	1.0%	1.0%	0.1%	1.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

Note: For L2, LP, EG and EN drivers consult chart on page 7 to confirm appropriate dimming curve for compatibility with selected control.

LISTING
cTUVus listed to UL1598 standard for Dry / Damp and Wet locations. Chicago Plenum, Airtight and Title 24 JA8-2019 Listed.

WARRANTY
Manufacturer's 1-year warranty guarantees product(s) listed to be free from defects in material and workmanship under normal use and service. 5-year warranty on LED and power supply to operate with 70% of the original flux and remain within a range of 3 duv. 10-year Lutron Advantage limited warranty available on Lutron equipped systems. Warranty period begins from the date of shipment by Seller and conditional upon the use of manufacturer-supplied power supply. Consult website for full warranty terms and conditions.

CHANGE LOG
1. 01/12/2021: ADDED 2200K, 2700K-1800K WARM DIM AND 10 DEGREE OPTIC OFFERINGS.
2. 04/30/2021: REMOVED QUICK SHIP.

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FRAXION3 SLIM FIXED

DIMMING COMPATIBILITY

LUTRON DRIVER COMPATIBILITY

Power supply **L2** **Lutron Product Family**	**Part No.**
Maestro WirelessR 600 W dimmer	MRF2-6ND-120-
Maestro WirelessR 1000 W dimmer	MRF2-10ND-120-
Caséta® Wireless Pro 1000 W dimmer	PD-10NXD-
GRAFIK T™ CL® dimmer	GT-250M- GTJ-250M-
HomeWorks® QS adaptive dimmer	HQRD-6NA-
HomeWorks® QS 600 W dimmer	HQRD-6ND-
HomeWorks® QS 1000 W dimmer	HQRD-10ND-
RadioRA® 2 adaptive dimmer	RRD-6NA-
RadioRA® 2 1000 W dimmer	RRD-10ND
myRoom™ DIN power module	MQSE-4A1-D
HomeWorks® QS DIN power module	LQSE-4A1-D
HomeWorks® QS wallbox power module	HQRJ-WPM-6D-120
HomeWorks® wallbox power module	HWI-WPM-6D-120
GRAFIK Eye® QS control unit	QSGR-, QSGRJ-
GRAFIK Eye® 3000 control unit	GRX-3100- GRX-3500-
RPM-4U module (LCP, HomeWorks® QS, GRAFIK Systems™, Quantum®)	HW-RPM-4U-120 LP-RPM-4U-120
RPM-4A module (LCP, HomeWorks® QS, GRAFIK Systems™, Quantum®)	HW-RPM-4A-120, LP-RPM-4A-120
GP dimming panels	Various
Ariadni CL 250W dimmer	AYCL-253P-
Diva CL 250W dimmer	DVCL-253P- DCSCCL-253P-
Nova T CL 250W dimmer	NTCL-250-
Power supply **LP** **Lutron Product Family**	**Part No.**
PowPak Dimming Modules	RMJ-ECO32-DV-B
PowPak Dimming Modules	FCJ/FCJS-ECO
Energi Savr Nodes	QSN-1ECO-S
GRAFIK Eye QS control unit Homeworks QS control unit	QSN-2ECO-S
GRAFIK Eye QS control unit Homeworks QS control unit	QSGRJ-_E (wireless) QSGR-_E
Quantum Hub	QP2-_ _ 2C
Quantum Hub	QP2-_ _ 4C
Quantum Hub	QP2-_ _ 6C
Quantum Hub	QP2-_ _ 8C
Homeworks QS power module myRoom Plus power module	LQSE-2ECO-D

LUTRON
2016 OEM ADVANTAGE ACCOUNT

eldoLED DRIVER COMPATIBILITY

Power supply **EG / EN** **Dimmer / Switch Control Manufacturer**	**Family/Model #**
Busch-Jaeger	2112U-101
Jung	240-10
Leviton Lighting Controls	IP710-DLX
Lightolier Controls	ZP600FAM120
Lutron Electronics	Nova T® - NTFTV
Lutron Electronics	Diva® - DVTV
Lutron Electronics	Nova® - NFTV
Merten	5729
Pass & Seymour	CD4FB-W
The Watt Stopper	DCLV1
Sensor Switch	nIO EZ
Synergy	ISD BC
Power supply **EG / EN** **Lighting Control System Manufacturer**	**Family/Model #**
Lutron Electronics	GrafixEye® GRX-TVI w GRX3503
Lutron Electronics	Energy Savr Node™ - QSN-4T16-S
Lutron Electronics	TVM2 Module
Crestron®	GLX-DIMFLV8
Crestron®	GLXP-DIMFLV8
Crestron®	GLPAC-DIMFLV4-*
Crestron®	GLPAC-DIMFLV8-*
Crestron®	GLPP-DIMFLVEX-PM
Crestron®	GLPP-1DIMFLV2EX-PM
Crestron®	GLPP-1DIMFLV3EX-PM
Crestron®	DIN-AO8
Crestron®	DIN-4DIMFLV4
Crestron®	CLS-EXP-DIMFLV
Crestron®	CLCI-1DIMFLV2EX
ABB	SD/S 2.16.1

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Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

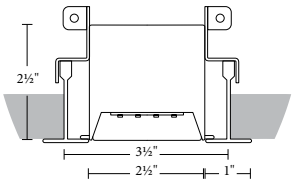
High Performance 2.5" Aperture (HPX) Recessed

The High Performance 2.5" Aperture (HPX) is a patented LED linear luminaire with a square micro profile and internal driver design. This Line-of-Light luminaire delivers excellent performance and is equipped with a unique LED configuration for superior illumination. HPX can be tailored from 2' to 12' sections in 1' increments and is available in Pendant, Surface Mount, and Recessed.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

CROSS SECTIONS

Recessed



Flush Downlight Diffuser
(standard)

ALSO AVAILABLE IN

Pendant
(**ID, D**)

Surface Mount
(**SM**)

LUMEN OUTPUT PACKAGES

S	B	H	V
Standard	Boosted Standard	High	Very High

PERFORMANCE

Up to **2057** **Lumens** per **Foot**

Up to **125** **Lumens** per **Watt**

Fine TUNE GENERATION 1 Option Available

Protected by one or more US Patents: 8915613; 9681516,B2; D702,390

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Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

Clear Form

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Run Length of Configuration
◉ **HP** - High Performance	◉ **X** - 2.5" Square	◉ **R** - Recessed	◉ **D** - Direct	_____ Minimum 2' section length. Increments of 1'; 12' maximum section length

OUTPUT AND LED TYPE | **MECHANICAL/ OPTICAL OPTIONS** | **ELECTRICAL OPTIONS**

Downlight Output	CCT and CRI	Downlight Option	Voltage	Circuiting
◯ **S** - Standard ◯ **B** - Boosted Standard ◯ **H** - High ◯ **V** - Very High ◯ **TL** - Tailored: _____ lm/ft * * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.	◯ **830** - 80 CRI min, 3000K ◯ **835** - 80 CRI min, 3500K ◯ **840** - 80 CRI min, 4000K ◯ **930** - 90 CRI min, 3000K ◯ **935** - 90 CRI min, 3500K ◯ **940** - 90 CRI min, 4000K ◯ **8TW** - 80 CRI min, Tunable White ◯ **9TW** - 90 CRI min, Tunable White	◉ **F** - Flush	◯ **120** - 120 Voltage ◯ **277** - 277 Voltage ◯ **347** - 347 Voltage	◯ **SC** - Single Circuit* One single circuit in a run ◯ **MC** - Multi Circuit* More than one switch leg or zone (not 'DC' indepedent control of up and down separately for an I/D style fixture). Factory shop drawings required *Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS | **MOUNTING OPTIONS**

Driver Selection	Ceiling Hardware Type
0-10V Driver Options ◯ **FC-10%** - 0-10V 10% (standard) [2] ◯ **FC-1%** - 0-10V 1% [2] ◯ **OSR-10%** - Osram OTi, 0-10V 10% ◯ **OSR-1%** - Osram OTi, 0-10V 1% [2] ◯ **ELD-10V** - EldoLED SOLOdrive, 0-10V 0.1% ◯ **10V-TW** - Osram OTi, 0-10V 10% *(Tunable White)* [2] **DALI Driver Options** ◯ **FC-DALI** - DALI 1% ◯ **OSR-DALI** - Osram Dexal, 1% ◯ **ELD-DALI** - EldoLED SOLOdrive, DALI 0.1% ◯ **DALI-TW** - EldoLED Dual Drive Light Shape, 1% *(Tunable White)* **DMX Driver Options** ◯ **FIN-DMX** - Finelite DMX 1% *(Tunable White - FineTUNE Controls Only)* ◯ **DMX** - EldoLED POWERdrive, 0.1% ◯ **DMX-TW** - EldoLED POWERdrive, 0.1% *(Tunable White)* **Lutron Driver Options** ◯ **LUT-ES1** - Lutron, Ecosystem 1% ◯ **LUT-2W** - Lutron, 2-wire (120v only) 1% ◯ **LUT-TW** - Lutron T-Series, EcoSystem 0.1% *(Tunable White)* See Page 3 for additional driver options and details	◯ **C1** - 1" T-Bar ◯ **C2** - 9/16" T-Bar ◯ **C3** - Screw Slot ◯ **SF** - Spackle Flange

OTHER OPTIONS

Endcap Style	Finish	Emergency Style (Optional) Clear Selection	Integrated Sensor (Optional) Clear Selection	Special Options (Optional) Clear Selection
◉ **FE** - Flat Endcap	◯ **SW** - Signal White ◯ **FB** - Finelite Black ◯ **SA** - Satin Aluminum ◯ **####** - RAL Color Code [4] _____	◯ **LGD18W** - Legrand 18W Brand Battery Back-up ◯ **LGD10W** - Legrand 10W Brand Battery Back-up ◯ **EM/GEN** - Emergency to Generator ◯ **NL** - Night Light ◯ **BSL310LP** - Bodine Battery Back up Low Profile ◯ **GTD** - Generator Transfer Device ◯ **ALCR** - Automatic Load Control Relay	◯ **OBO** - Occupancy ◯ **OBD** - Daylight ◯ **W601** - Wattstopper [5] Wireless Sensor ◯ **OBE** - Enlighted [6]	◯ **CP** - Chicago Plenum ◯ **RLA** - Red List Approved ◯ **RLD** - Declare

1 Contact factory for switching options
2 Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
3 B & V outputs only
4 20 Business day lead time for color
5 LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected.
LMFS-601 w/ Dali driver, only 1 driver can be connected.
6 Enlighted components installed by Finelite; Provided by other

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Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TWDTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120v only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system, plug-together wiring, standard.

LENGTHS: Any length, 2' minimum section length. Increments of 1'. 12' maximum section length.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). A separate chart summarizes lumen distribution and wattage. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION: 12' maximum diffuser length. Flush (**F**) frost white snap-in diffuser, standard; 73% transmissive, 99% diffusion

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

ELECTRICAL OPTIONS

STATIC WHITE FEED: 18-gauge/5-conductor single-circuit feed wire, standard. 14-gauge feed wire used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10% - 100%. Dimming to 1% available; Consult factory. Driver is fully accessible from below the ceiling.

- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS:

- **LUTES1** Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series)
- **LUTES5** 5-Series 5% EcoSystem (LDE5 Series)
- **LUT2W** Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series);

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V/277V.

- **Power factor** ≥0.9
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100 - 1%
- **Expected driver lifetime:** 100,000 hours

LUTRON TUNABLE WHITE DRIVER OPTION: LUTDTW 1% T-Series 2-Channel Digital Tunable White (PSQ Series).

MOUNTING TYPE

HANGING HARDWARE:

- **Recessed Spackle Flange:** Drywal surfaces (walls or ceilings): 1/4" - 20 stud and nut (provided by others). Mounted with three equidistant suspension points.
- **Recessed T-Bar:** Standard bracket design works with most lay-in ceiling types. Brackets secure luminaire to the ceiling grid from above. Tie-in T-Bar brackets connect the luminaire to the T-Bar for securing to structure. Consult local codes for tie-wire recommendations.

OTHER OPTIONS

ENDCAPS: Flat endcaps (**FE**) at each end of run add 1/16" to each end of luminaire.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery

	Legrand 18W	Legrand 10W/ Bodine BSL310LP
HPX-R-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	2024	1202
EM Section Illuminated	2'	2' or 4'

* Minimum fixture housing length for battery pack approved without sensor
** Exception: 5' not available, 6'+ okay.

TUNABLE WHITE ELECTRICAL OPTIONS:

- **TW Driver Options 0-10V:** EM/GEN, GTD, or Battery Back-up
- **FineTune DMX:** EM/GEN or Battery Back-up
- **DMX:** Battery Back-up
- **DALI:** EM/GEN, GTD, or Battery Back-up
- **LUTRON:** EM/GEN, GTD, or Battery Back-up

Bodine GTD and Legrand ALCR Min. Length

Configuration	Min Length
Generator	4'
Generator + OCC	6'
Daylight	4'
Generator + Daylight	6'

Continued

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2.5" Aperture (HPX) Recessed

SPECIFICATIONS

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options.

FINISHES: Finelite Signal White (**SW**) powder coat standard. Finelite Black (RAL 9005) with semi gloss fine texture (**FB**) [1] and satin Aluminum (**SA**) [1] are available. Optional Adders: 185 RAL colors. [1]

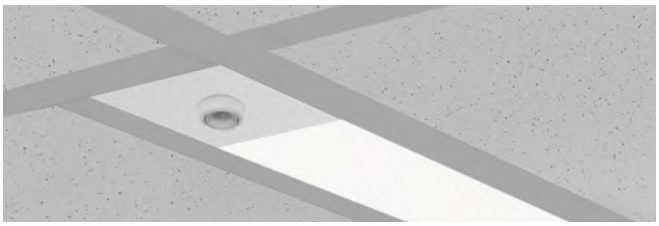
LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request, contact factory for more details. These fixtures are rated for Damp Location. IC Rated. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. HPX can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT: 2.3 lb/ft.

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

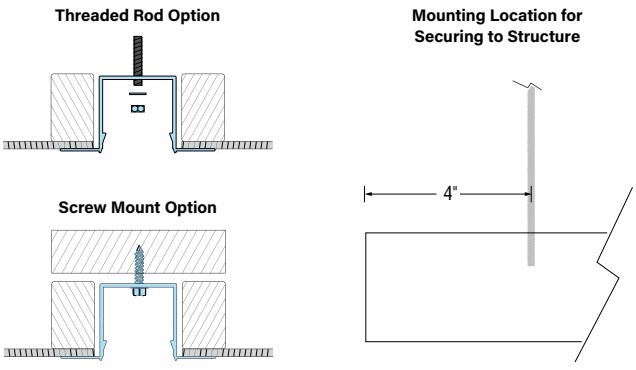
[1] 20 business day lead time for color

INTEGRATED SENSOR



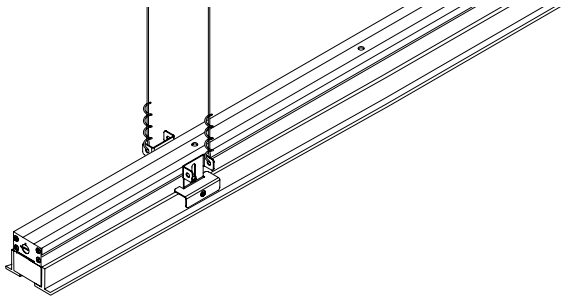
Integrated PIR (Passive Infrared) occupancy or daylight sensors available with Flush and Bottom Glow downlight diffusers. Refer to Occupancy Sensor and Daylight Sensor tech sheets for more info.

HARD CEILING MOUNTING OPTIONS



Two mounting options: threaded rod and screw mounting options. Mounting locations are located on each end of the luminaire. Mounting location is 4" away from each end of luminaire

T-BAR INSTALLATION



HPX-R for T-Bar installations comes standard with a splice plate at the end of the luminaire. Mounting brackets (supplied) secure the luminaire to T-Bar and provide support to structure location. All even foot length (2, 4, 6...) luminaire runs are reduced in length an appropriate amount to fit within typical 2×2 and 2×4 T-Bar grid systems. For uncommon T-Bar systems please consult factory.

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Type:	Project:	
Ordering Info:		

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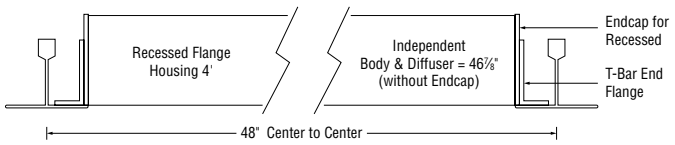
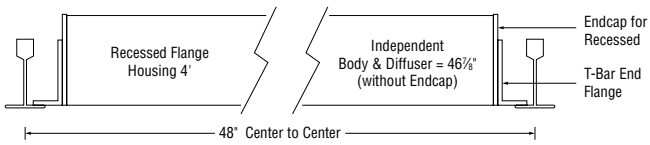
High Performance 2.5" Aperture (HPX) Recessed

GRID LENGTH DETAIL - 4' EXAMPLE

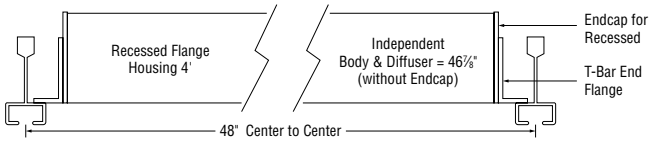
1" T-Bar



9/16" T-Bar

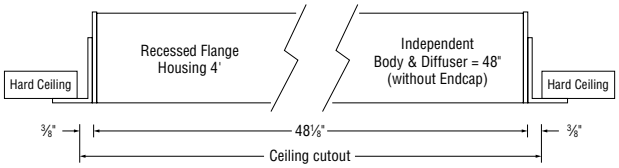


9/16" Screw Slot



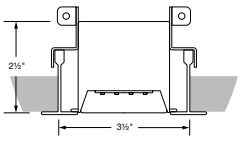
HARD CEILING LENGTH DETAIL - 4' EXAMPLE

Spackle Flange

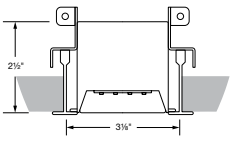


RECESSED MOUNTING TYPES T-BAR

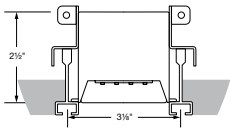
Rough-In Dimensions



1" T-Bar (C1)

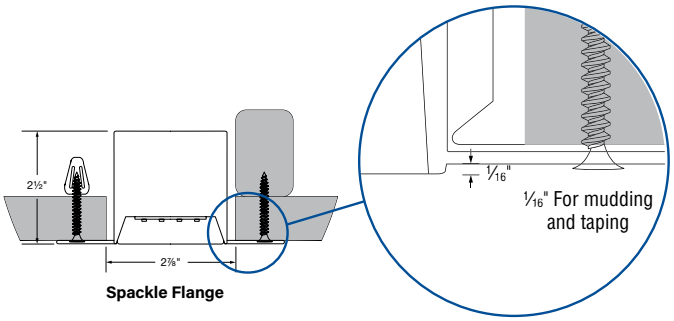


9/16" T-Bar (C2)



Standard Screw Slot (C3)

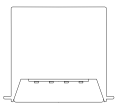
RECESSED MOUNTING TYPES CUTOUT DIMENSIONS



Spackle Flange

HOUSING

Version 3



Ceiling Options C1, C2, C3

Version 4

Ceiling Option SF

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

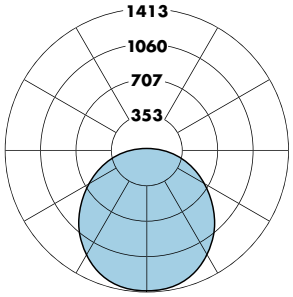
High Performance 2.5" Aperture (HPX) Recessed

Recessed Photometry

4' Luminaire 3500k

HPX-R-D-V-835-F

Efficacy: 124 lm/W
Total luminaire output: 4127 lumens (1032 lumens/ft)
33.2 watts (8.3 watts/ft)
Peak Candela Value: 1413 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 93256



CANDLEPOWER SUMMARY

	0.0	22.5	45.0	67.5	90.0	Flux
0	1413	1413	1413	1413	1413	
5	1409	1407	1408	1408	1407	134
15	1363	1354	1360	1361	1358	383
25	1267	1253	1264	1264	1261	581
35	1127	1116	1126	1123	1119	702
45	951	945	950	946	944	731
55	746	743	747	743	741	665
65	520	521	523	522	522	517
75	292	295	298	299	300	315
85	89	88	91	91	91	100
90	0	0	0	0	0	

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaure			
S[1]	**B[1]**	**H[1]**	**V[2]**
1689	2124	3210	4127

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S[1]	**B[1]**	**H[1]**	**V[2]**
422	531	802	1032

Power, 3500K, CRI (Watts Per Foot)			
S[1]	**B[1]**	**H[1]**	**V[2]**
3.2	4.1	6.4	8.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S[1]	**B[1]**	**H[1]**	**V[2]**
130	129	126	124

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 3210 lm x 0.789 = 2533 lm

Total Light Output per Foot: 802 lm x 0.789 = 633 lm

watts/foot: 6.4 W/ft.

Efficacy = $\frac{633 \ \frac{\text{lm}}{\text{ft.}}}{6.4 \ \frac{\text{W}}{\text{ft.}}}$ = 99 lm/W

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 93256

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

0-10V Tunable White

Finelite's award-winning, contractor friendly Tunable White luminaires are available at low cost, with powerful and simple 0-10V tuning and intensity controls.

TUNABLE WHITE FEATURES

- CCT range: 2700K - 6500K
- Dimming Range: 100% to 10%
- CRI Options: 80 CRI or 90 CRI

LUMINAIRE FAMILY MODIFICATIONS/RESTRICTIONS

	Section Lengths										
Recessed Direct	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'
Output S,B,H,V Single Circuit	Rows can be comprised of 2'-12' sections.										
Integral Battery Backup (BSL310LP)							✓		✓		✓

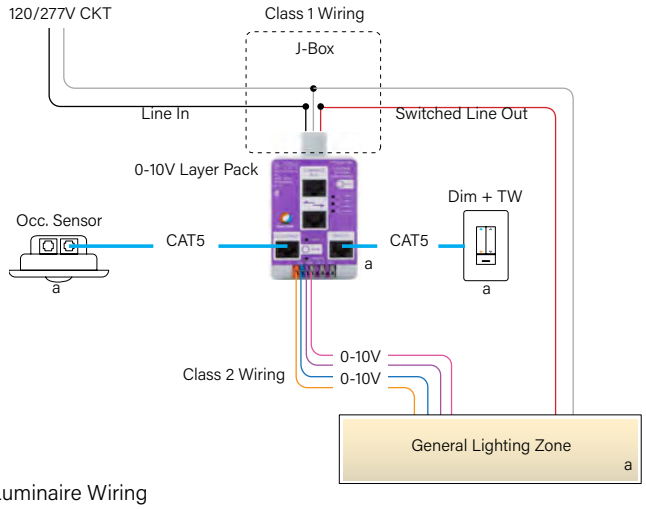
PHOTOMETRY

Apply a power adjustment factor to calculate wattage usage

POWER	CONVERSION FACTOR
	1.1X

(Example: a 50 watt luminaire in static white would draw 55 watts using 0-10V Tunable White)

WIRING DIAGRAM - DIMMABLE TO 10%



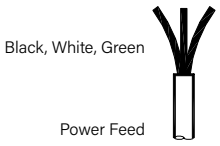
Luminaire Wiring

- **Purple** (+) / **Pink** (-) control wires are for intensity control
- **Orange** (+) / **Blue** (-) control wires are for Tunable White control

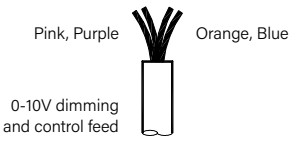
Note:
Load or Dim to Off options available.

EN/GEN sections available for all body lengths

DUAL FEED DETAIL



WIRING LEGEND		
Black	Hot	Line Voltage
White	Neutral	Line Voltage
Green	Ground	

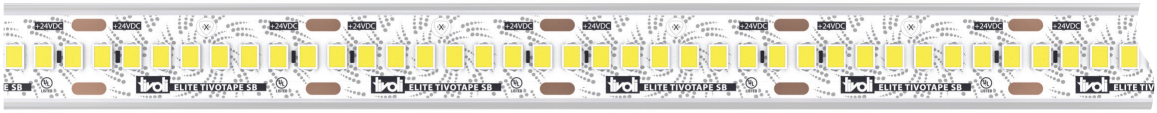


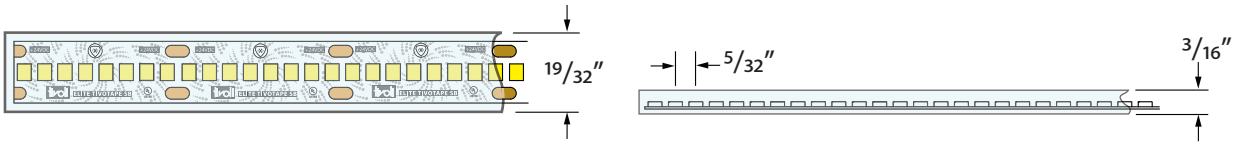
WIRING LEGEND		
Pink	Dimming	0-10V DC
Purple	Dimming	0-10V DC
Orange	TW	0-10V DC
Blue	TW	0-10V DC

Tunable White LUMINAIRES

ELITE | TivoTape™ Outdoor (factory installed power lead wires)

Standard Brightness (SB)






3.2W/ft
328LM/ft


4oz. Trace

High Efficacy

99 CRI

Compliant

VHB Adhesive

Silicone Jacket


2200K 2400K 2700K 3000K 3500K 4000K 5000K

Ordering Information

PRODUCT CODE		INTENSITY		INSTALL		LED COLOR		VOLTAGE
TPLE	-	SB	-	O	-		-	24

TPLE = TivoTape ELITE

SB = Standard Brightness

O = Outdoor

22 = 2200K
24 = 2400K
27 = 2700K
30 = *3000K
35 = 3500K
40 = 4000K
50 = 5000K

24 = 24V DC

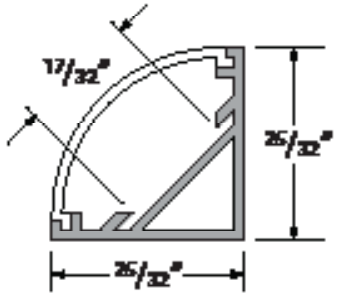
TivoTape Run Lengths & End Preps
Please specify length of run with quantity of run(s) and end prep type at time of ordering.
Note: Only (1) end prep needed for each run (see page 19)

*This product is in compliance with the California Energy Code Title 24 JA8-2016 in 3000K and only when incorporating a specific power supply.

www.tivolilighting.com tel: 714-957-6101 fax: 714-427-3458

GUIDE | Marsala

PROFILE DIMENSIONS



AVAILABLE TIVOTAPE™ OPTIONS

SB **XS** **HO** **HD** **ELITE**

2200K 2400K 2700K 3000K

3500K 4000K 5000K

VHO

3000K 3500K

Tunable White

2200K 3000K

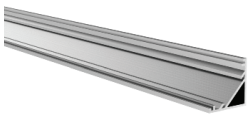
2700K 4000K

2200K 6500K

RGB

RGBW

ORDERING INFORMATION



MRSL-CHAN-SLV-6.5
Anodized Aluminum Extrusion, available in 6.5' lengths

MRSL-LNS-OPL-6.5
Lens, opal, length 6.5'

MRSL-LNS-CLR-6.5
Lens, clear, length 6.5'

MRSL-LNS-DIF-6.5
Lens, diffuser, length 6.5'

MRSL-EC-01
Solid End Cap

MRSL-EC-02
Powerfeed End Cap

MRSL-CLP-SLV
Clip, Silver

NOT USED

NOT USED

brightline®
Evolutionary Lighting Systems

LED VideoPlus

Videoconference Fixture Plus Task Light

Construction
The fixture housing is made of 6063-T5 aluminum extrusions. The video light provides vertical illumination for videoconferencing while direct task light provides general room illumination. As an option, fixtures can be configured with task or video lights only.

Fixture Body Finish
Low-gloss Signal White finish (Ral #9003, smooth satin).

Drivers
All drivers are high-frequency electronic, with a power factor >.95, THD <10%, and a Class A sound rating. Drivers are mounted in the fixture module housing. The power and control inputs are on the back of fixtures. Operational voltage is universal, 120 - 277V.

Low Voltage Control
19" Rack-mounted driver is available with up to 600w of power. Multiple drivers can be linked for any size project. Low voltage control available for 120-230V applications.

Power Over Ethernet Control
Fixture are available with PoE control nodes. Consult with factory for specification of complete PoE systems. PoE control available for 120-230V applications.

LED Technology
The fixture utilizes mid-power LEDs with high-quality illumination (>90 CRI) for videoconferencing and general lighting applications. Each 2-foot fixture has a power consumption of 32 watts per channel, each 4-foot fixture has a power consumption of 64 watts per channel.

Directional Beam Angle
The two video components are positioned at a 45° angle. The task component emits a 55° beam angle. The beams overlap slightly, creating a combined field of light.

Accessories
Louvers provide complementary aesthetics to most architectural styles. Louvers available in white or custom finish. Glare reduction filter is integral to the fixture. 45°-angle mounting panel is available for 2-ft fixtures only.

Fixture Dimensions, Aperture and Weight

2-foot: Inch 23.75-in x 9.85-in x 7.50-in
(603.25-mm) x (248.92-mm) x (190.50-mm)
Aperture: 5.00-in x 23.55-in
(127.00-mm) x (598.17-mm)
Fixture weight: 30-lbs* (13.61-kg)

4-foot: Inch 47.75-in x 9.85-in x 7.50-in
(1212.85-mm) x (248.92-mm) x (190.50-mm)
Aperture: 5.00-in x 47.55-in
(127.00-mm) x (1207.77-mm)
Fixture weight: 60-lbs* (27.22-kg)

* Weight provided is for Double VideoPlus configuration; consult factory for weights for other configurations. Weight is approximate.

See shipping information chart for gross weights and dimensions.

Certifications
UL/cUL

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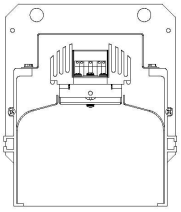
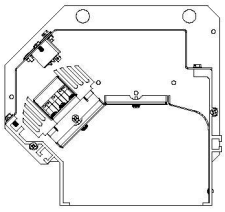
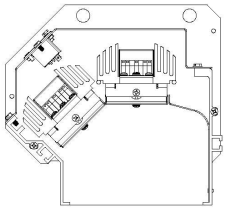
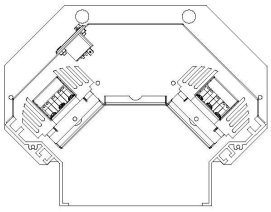
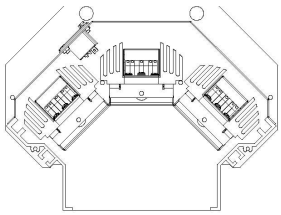
LED VideoPlus
Videoconference Fixture Plus Task Light

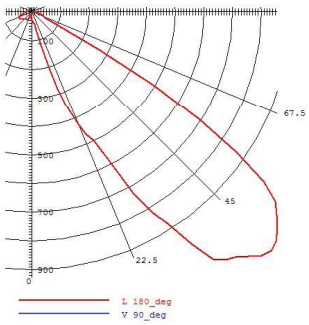

Task Only


Video Only

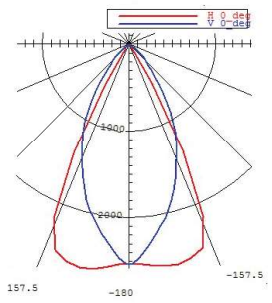

Video + Task


Double Video

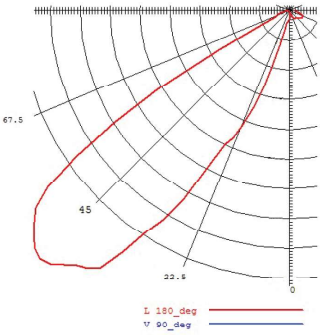

Double Video + Task



Video Light with Lens
45° vertical light distribution



Task Light
90° horizontal light distribution



Video Light with Lens
45° vertical light distribution

LVP		-			-		-		-		-	
Video Plus	Length		Dimming Protocol	Color Temperature		Video LED		Task LED		Video LED		Panel Option (2-ft fixtures only)
	2 = Two Foot		A = 0-10V	30 = 3000K / 97 CRI		V = Yes		T = Yes		V = Yes		I45 = Imperial 45°
	4 = Four Foot		E = Lutron LDE1	35 = 3500K / 97 CRI		0 = No		0 = No		0 = No		M45 = Metric 45°
			X = DALI	40 = 4000K / 97 CRI								
			L = Low Voltage DMX (remote driver)	50 = 5000K / 97 CRI								
			Z = PoE (60W)*									

Notes:
Consult factory to ensure PoE system compatibility.
Consult factory for additional color temperatures.

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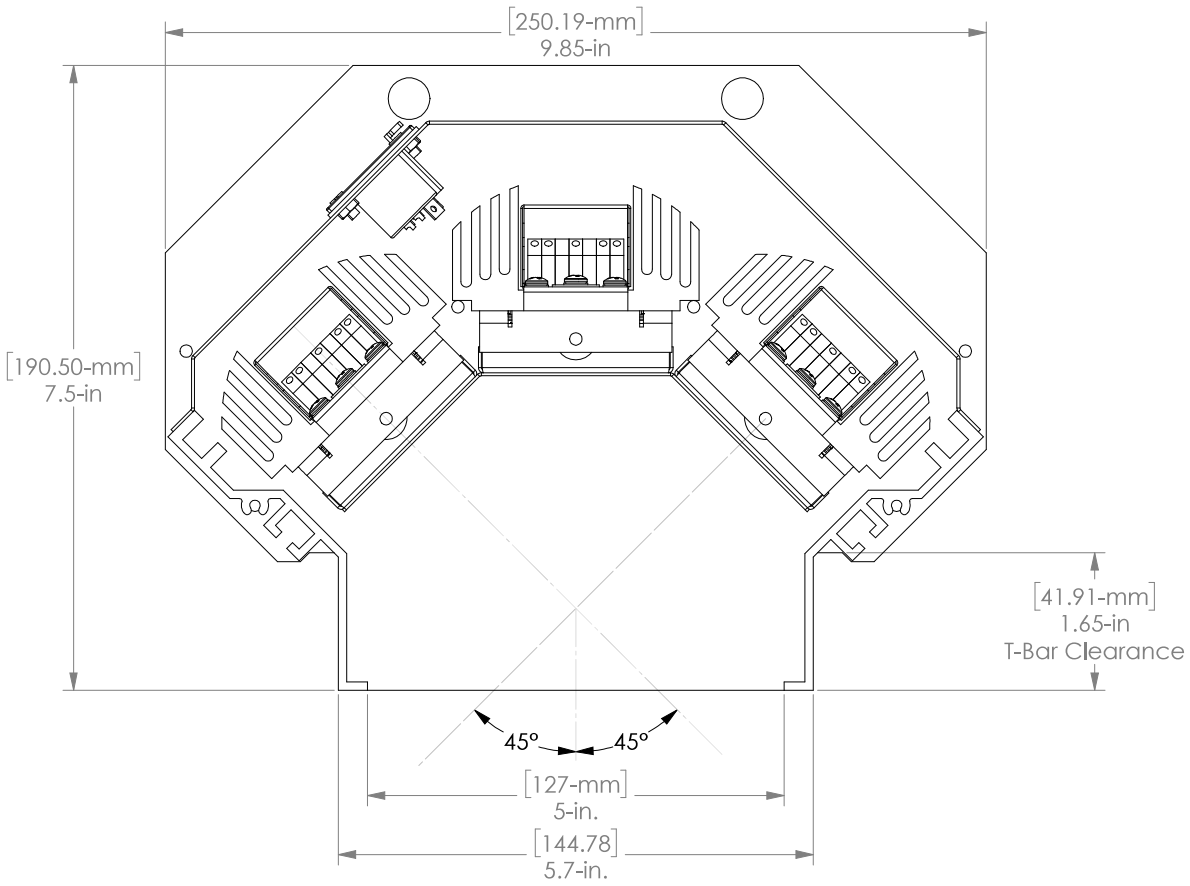
LED VideoPlus

Videoconference Fixture Plus Task Light

Section View



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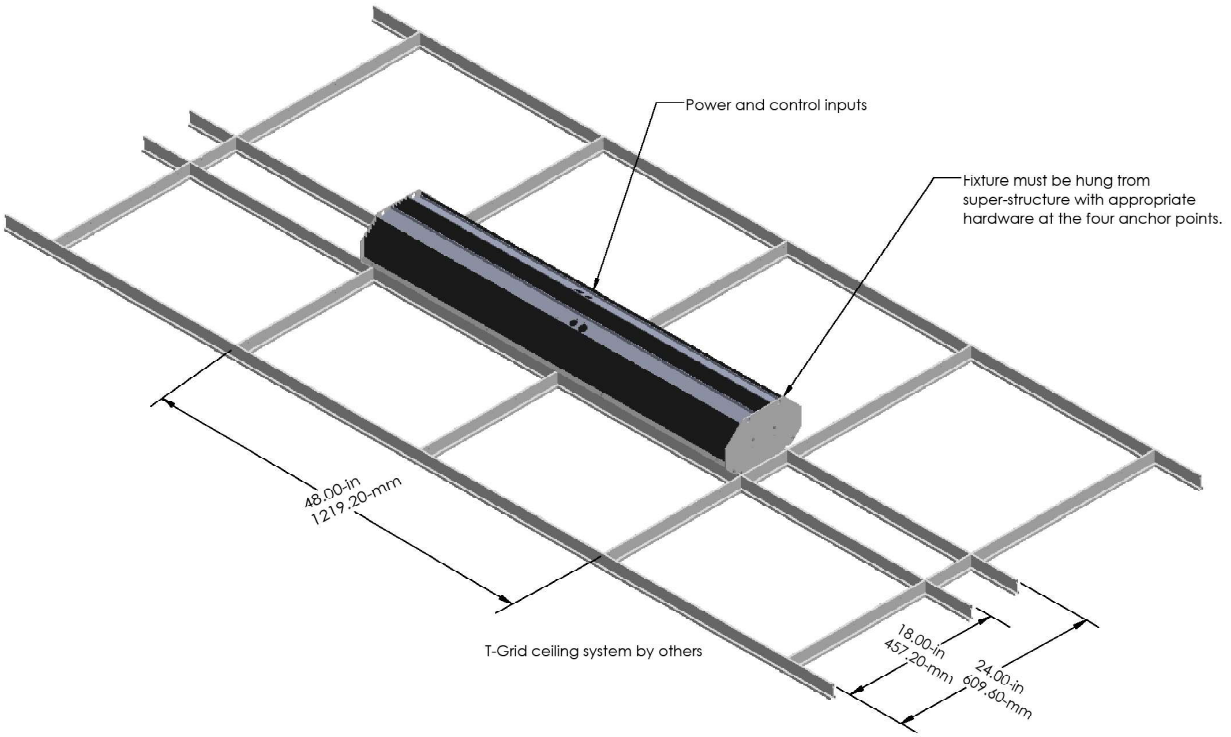
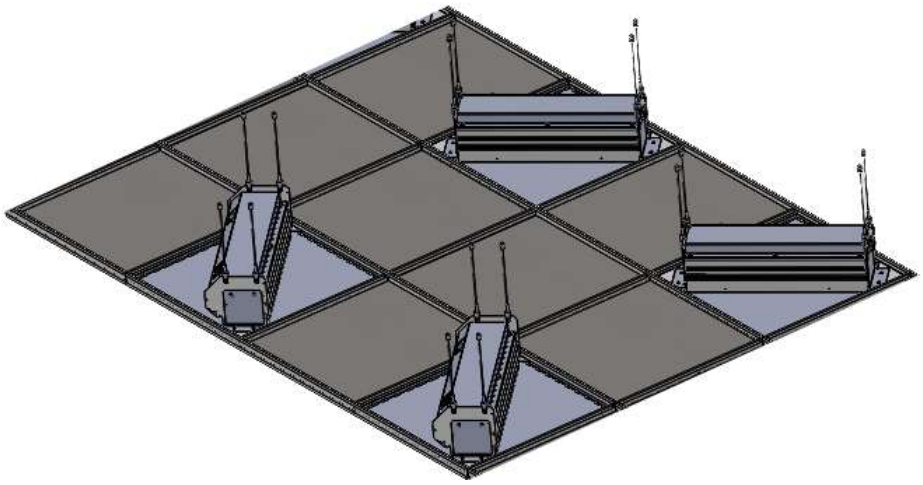
Videoconference Fixture Plus Task Light

Standard Ceiling Grid Installation



45°-angle Fixture Ceiling Grid Installation



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08/05/21

CONTECH LIGHTING | a LEVITON company

CATALOG NO.

DATE PROJECT TYPE

CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

	CYL61	CYL62	CYL63	CYL64	CYL65	CYL66
WATTAGE	10W	14W	20W	28W	37W	43W
LUMEN OUTPUT[1]	1000Lm	1400Lm	2000Lm	2600Lm	3200Lm	3600Lm
COLOR TEMPERATURE	2700K, 3000K, 3500K, 4000K					
CRI	83 (80min) / 90+					
SYSTEM RATING	50,000 Hours @ 70% Lumen Maintenance					
REFLECTORS	36° Narrow Clear, 54° Medium Clear, 57° Medium Platinum, 80° Wide Clear, Wall Wash, Pencil Beam					
MOUNTING	Ceiling, Flexible Cable Pendant with Canopy, Rigid Stem Pendant with Canopy, Flexible Cable Pendant with Track Adapter, Wall Mount Up Light or Down Light, Up/Down Wall Mount					
DRIVER INPUT WATTAGE	10W	14W	20W	28W	37W	43W
DRIVER INPUT CURRENT (A) 120V/277V	.08/.04	.12/.06	.17/.08	.23/.11	.31/.14	.36/.17
DRIVER POWER FACTOR	> 0.90					
THD	< 20%					
LISTING	cCSAus Certified for use in the U.S. and Canada. Ceiling, Rigid Stem Pendant, Up/down, and Wall mount models available as Damp/Dry or Wet location models. Flexible Cable Pendant Mount only available as Damp/Dry location model. ENERGY STAR® Certified for all Mounting Options except Up/Down Wall Mount ENERGY STAR® Certified for all Reflector Options except Pencil Beam and Wall Wash Reflectors					
WARRANTY	Five (5) year replacement after date of purchase					

1. Lumen values are approximate, see photometric test results

Ceiling Mount

Flexible Cable Pendant Mount

Rigid Stem Pendant Mount

Flexible Cable Pendant with Track Adapter

Wall Mount Down Light

Wall Mount Up Light

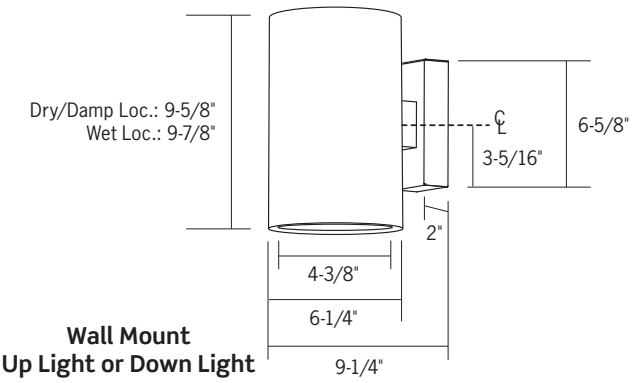
Up/Down Wall Mount

CONTECH LIGHTING | a LEVITON company

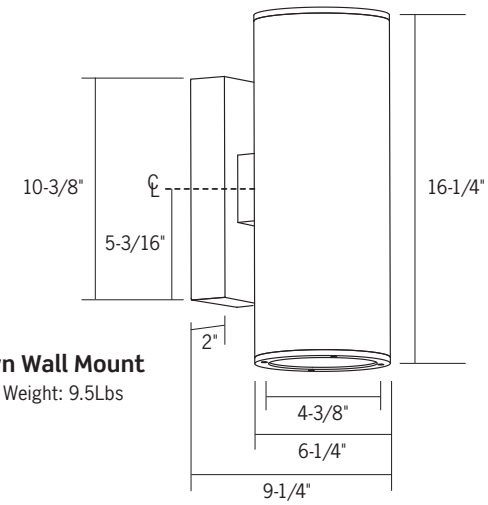
CATALOG NO.

DATE PROJECT TYPE

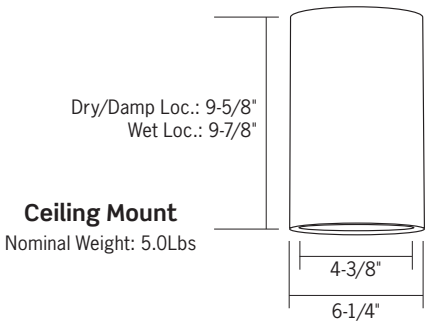
CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders



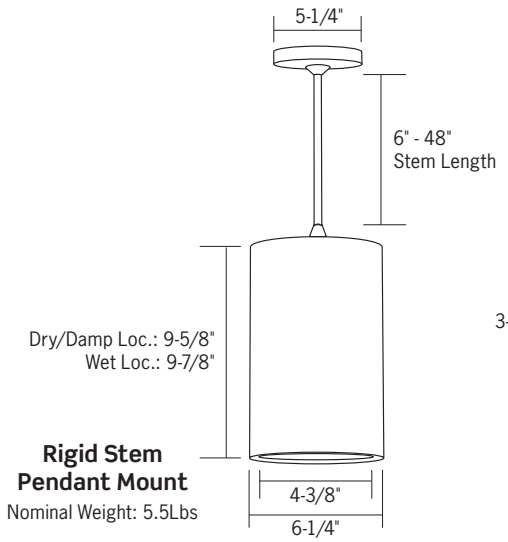
Wall Mount
Up Light or Down Light
Nominal Weight: 6.0Lbs



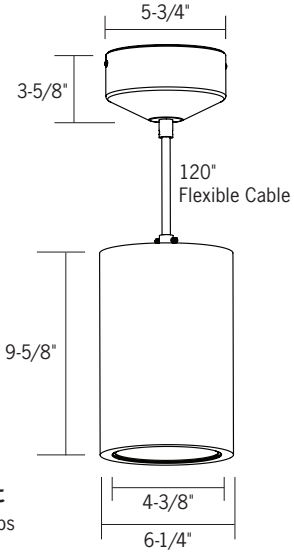
Up/Down Wall Mount
Nominal Weight: 9.5Lbs



Ceiling Mount
Nominal Weight: 5.0Lbs



Rigid Stem
Pendant Mount
Nominal Weight: 5.5Lbs



Flexible Cable
Pendant Mount
Nominal Weight: 6.0Lbs

REV0721

P2

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CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

ORDERING INFORMATION

Example Order: CYL6127KMVD4FCXNCLR — BZ

Luminaire/ LED Series
- **CYL61** - 10W/ 1000lm
- **CYL62** - 14W/ 1400lm
- **CYL63** - 20W/ 2000lm
- **CYL64** - 28W/ 2600lm
- **CYL65** - 37W/ 3200lm
- **CYL66** - 43W/ 3600lm

Color Temp/CRI

83 (80min) CRI
- **27K** - 2700K
- **30K** - 3000K
- **35K** - 3500K
- **40K** - 4000K

90+ CRI
- **27KC** - 2700K
- **30KC** - 3000K
- **35KC** - 3500K
- **40KC** - 4000K

Driver/Dimming
- **MVD** - 120V-277V TRIAC, ELV, 0-10V Dimming
- **34D2** - 347V, 0-10V Dimming
- **12D3** - Lutron Hi-lume 1% 2-Wire LED Driver (120V Forward Phase Only)
- **MVD4** - Lutron Hi-lume 1% EcoSystem LED Driver with Soft-on, Fade-to-Black
- **MVD6** - eldoLED ECOdrive 0-10V, 1% Dimming
- **MVD7** - eldoLED ECOdrive DALI, 1% Dimming
- **MVD8** - eldoLed SOLOdrive 0-10V, 0.1% Dimming
- **MVD9** - eldoLED SOLOdrive DALI, 0.1% Dimming
- **MDMX** - eldoLED POWERdrive DMX <1% Dimming

Mounting
- **C** - Ceiling Mount
- **FC**[1] - Flexible Cable Pendant Mount
- **P**[2] - Rigid Stem Pendant Mount
- **W** - Down Light Wall Mount
- **U** - Up Light Wall Mount
- **UD**[3] - Up/Down Wall Mount
- **TFC**[4] - Flexible Cable Pendant with Track Mount Adapter

Mntg Location
- Interior Dry/Damp Locations, Leave Blank
- **X** - Exterior/Wet Locations

Reflector
- **NCLR** - 36° Narrow, Clear Alzak
- **MCLR** - 54° Medium, Clear Alzak
- **WCLR** - 80° Wide, Clear Alzak
- **PL** - 57° Medium, Platinum
- **WW**[5] - Wall Wash
- **PB**[5,6] - Pencil Beam

—

Finish
- **B** - Matte Black
- **BZ** - Satin Bronze
- **P** - Matte White
- **S** - Matte Silver
- **CC**[7] - Custom Color

—

Battery and Remote Enclosure
- None, Leave Blank
- **RDB**[8] - Remote Driver & Battery Pack
- **RD** - Remote Driver Enclosure

Stems for Rigid Stem Pendant Mount (P)

Rigid Stem Pendant Mount Option includes a Slope Ceiling Canopy and 6-inch Stem. Extra stem lengths must be ordered separately as needed. Maximum Stem Length: 8 Ft. 6-inches; consult factory for longer lengths.
- **6" STEM(A)** - 6" Stem
- **12" STEM(A)** - 12" Stem
- **18" STEM(A)** - 18" Stem
- **24" STEM(A)** - 24" Stem
- **30" STEM(A)** - 30" Stem
- **36" STEM(A)** - 36" Stem
- **48" STEM(A)** - 48" Stem
- **COUPLING** - Stem Coupling

—

Finish
- **B** - Matte Black
- **BZ** - Satin Bronze
- **P** - Matte White
- **S** - Matte Silver
- **CC**[7] - Custom Color

1. *Flexible Cable Pendant Mount Versions are only available in Dry/Damp location type.*
2. *Rigid Stem Pendant Mount includes Slope Ceiling Canopy (up to 45°) and 6-inch Stem; extra stem lengths must be ordered separately as needed. Maximum Suspension Length: 8 Ft. 6-inches; consult factory for longer lengths.*
3. *Consult factory when different beams, color temperatures, or lumen packages are required in a single Up/Down Cylinder.*
4. *Flexible Cable Pendant with Track Adapter option is only available with MVD Driver wired to 120V; TRIAC/ELV Dimming capable. Satin Bronze (BZ) Finish comes with Black Track Adapter.*
5. *Wall Wash (WW) and Pencil Beam (PB) valid on all models except Up/Down Cylinder with Series 5 or 6 LED Module (leave reflector designation blank)*
6. *Pencil Beam (PB) optic limited to exterior mount ("X") location style*
7. *Custom finish colors available. Consult factory for pricing, minimum order quantities and lead time.*
8. *Consult factory for RDB options on Up/Down (UD) luminaires. RDB Option only available with MVD driver. RDB Enclosure must be installed in a Dry/Damp Location.*

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DATE PROJECT TYPE

CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

DRIVER AVAILABILITY MATRIX

Highest wattage for each driver style that will fit inside the luminaire

DRIVER*:	MVD 120V-277V TRIAC, ELV	12D3 Lutron Hi-lume	MVD4 Lutron EcoSystem	MVD6 eldoLED ECODrive	MVD7 eldoLED ECODrive	MVD8 eldoLED SOLODrive	MVD9 eldoLED SOLODrive	MDMX eldoLED POWERdrive	34D2 347V 0-10V
MOUNTING									
CEILING	All Series	All Series	All Series	Thru Series 5	Thru Series 5	Thru Series 5	Thru Series 5	N/A	All Series
FLEX CABLE	All Series	All Series	All Series	Thru Series 5	Thru Series 5	Thru Series 5	Thru Series 5	N/A	All Series
RIGID STEM	All Series	All Series	All Series	Thru Series 5	Thru Series 5	Thru Series 5	Thru Series 5	N/A	All Series
DOWN LIGHT	All Series	All Series	All Series	All Series	All Series	All Series	All Series	All Series	All Series
UP LIGHT	All Series	All Series	All Series	All Series	All Series	All Series	All Series	All Series	All Series
UP/DOWN	All Series	All Series	All Series	Thru Series 5	Thru Series 5	Thru Series 5	Thru Series 5	N/A	All Series
TRACK MOUNT	All Series	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**Driver sizes that do not fit in fixture may be ordered with a Remote Driver Housing (-RD)*

	CYL61	CYL62	CYL63	CYL64	CYL65	CYL66
DRIVER INPUT WATTAGE	10W	14W	20W	28W	37W	43W
DRIVER INPUT CURRENT (A) 120V/277V	.08/.04	.12/.06	.17/.08	.23/.11	.31/.14	.36/.17
DRIVER INPUT VOLTAGE						
Triac, ELV, 0-10V	120V AC, 50/60Hz 277V AC, 50/60Hz					
Lutron HiLume® Dimming	120V AC, 50/60Hz					
Lutron Eco-System® Dimming	120V AC, 50/60Hz 277V AC, 50/60Hz					
eldoLED ECOdrive/SOLOdrive	120V AC, 50/60Hz 277V AC, 50/60Hz					
DRIVER POWER FACTOR	> 0.90					
THD	< 20%					
DIMMING						
Triac, ELV, 0-10V	10-100%					
Lutron® Dimming	1-100%					
eldoLED ECOdrive	1-100%					
eldoLED SOLOdrive	0.1-100%					

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CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

PRODUCT DETAILS

Construction

- Specification grade 6" diameter aluminum housing for indoor and outdoor applications
- Driver canopy for flexible cable option is 16 gauge steel
- Ceiling, Pendant, Up/down, Wall Mount Down Light, and Wall Mount Up Light models are available in either Dry/Damp (Indoor) or Wet (Outdoor) Location types. Flexible Cable versions are only available in Dry/Damp Location type.
- Wet Location type cylinders feature a silicone sealed clear glass lens in a gasketed die-cast trim ring to ensure unit is watertight
- Available in Matte White, Matte Black, Matte Silver and Satin Bronze finishes. Black Flexible Cable with Black or Bronze Cylinders, White with White and Gray with Silver.
- Custom finish colors available. Consult factory for pricing, minimum order quantities and lead time.
- UL8750 and Class 2 compliant: RoHS compliant, U.S. only.
- Output over voltage, over current and short circuit protected.

Features

- Ceiling and Pendant Cylinders provide a hang support for hands-free wiring
- Wall Mount Cylinders employ a bracket which provides support for hands-free wiring
- Rigid Stem Pendant Mount Option includes a Slope Ceiling Canopy (up to 45°) and 6-inch Stem. Extra stem lengths must be ordered separately as needed. Maximum Stem Length: 8 Ft. 6-inches; consult factory for longer lengths. Stem thread: 1/4-18NPS.
- Flexible Cable Pendant Mount Cylinders include 120-inches of Field Adjustable 18/3 SJTOW Cable.

Performance Summary

- Optical system employs either a Clear or Platinum reflector. Clear reflector is available in Narrow (36°), Medium (54°) and Wide (80°) beam distributions. Platinum is only available in a single beam distribution (57°).
- Wall Wash and Pencil Beam optic accessories are also available on select models
- Select from 2700K, 3000K, 3500K and 4000K color temperatures; CRI 80 min., 83 typical; High CRI 90+ available
- Excellent fixture-to-fixture color consistency within a 3-step MacAdam Ellipse tolerance
- Wet Location models must be installed per specific product installation instructions and all appropriate National Electrical Codes
- All CYL6 Cylinders are available for non-dimming and dimming applications. For a list of compatible dimmers, refer to Dimming Specification sheet.
- Assembled in the U.S.A

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CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

PHOTOMETRICS

CYL6630KMVDCMCLR

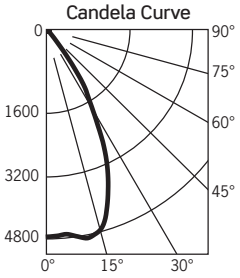
Fixture Delivered Lumens: 3603
Total Watts@120V: 43.0
Lumens Per Watt: 83.8
Center Beam Candle Power: 4747
Beam Distribution: 54°
Spacing Criterion: 0.82
Color Rendering Index (CRI)[1]: 83
Color Temperature (CCT)[2]: 2988K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. 85098
LM-79 Test No. 85099

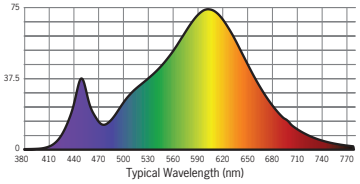
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	131.9	5.4
8'	74.2	7.2
10'	47.5	9.0
12'	33.0	10.8
14'	24.2	12.6
16'	18.5	14.4

Candela Curve



Spectral Power Distribution Chart[4]



CYL6630KMVDCNCLR

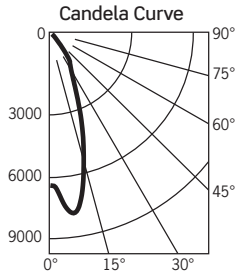
Fixture Delivered Lumens: 3567
Total Watts@120V: 43.0
Lumens Per Watt: 83.0
Center Beam Candle Power: 6579
Beam Distribution: 36°
Spacing Criterion: 0.63
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3027K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. 85317
LM-79 Test No. 85321

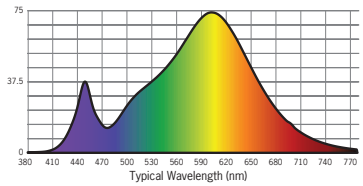
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	182.8	3.9
8'	102.8	5.3
10'	65.8	6.6
12'	45.7	7.9
14'	33.6	9.2
16'	25.7	10.5

Candela Curve



Spectral Power Distribution Chart[4]



CYL6630KMVDWCLR

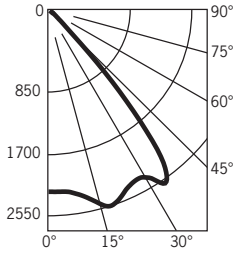
Fixture Delivered Lumens: 3749
Total Watts@120V: 44.4
Lumens Per Watt: 84.4
Center Beam Candle Power: 2248
Beam Distribution: 80°
Spacing Criterion: 1.19
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3025K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. 84842
LM-79 Test No. 85701

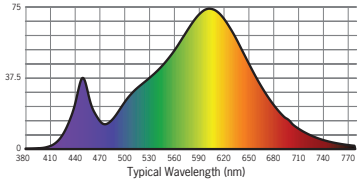
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	62.4	8.9
8'	35.1	11.9
10'	22.5	14.9
12'	15.6	17.9
14'	11.5	20.8
16'	8.8	23.8

Candela Curve



Spectral Power Distribution Chart[4]



1. Accuracy of rendering colors 2. Color appearance of light source 3. Dependent on surrounding temperatures 4. Colors present within the light source

PHOTOMETRIC MULTIPLICATION FACTORS

Lumen output values fluctuate based on CCT. To estimate lumen output of the various CCT/CRI options, multiply 3000K (80 CRI min) results by the following:

CCT	STD CRI	HIGH CRI	SERIES 1	SERIES 2	SERIES 3	SERIES 4	SERIES 5	WHT/PL REFLECT.
2700K	0.94	0.70	0.29	0.39	0.53	0.73	0.90	1.0
3000K	N/A	0.75	0.29	0.39	0.53	0.73	0.90	1.0
3500K	1.0	0.81	0.29	0.39	0.53	0.73	0.90	1.0
4000K	1.0	0.87	0.29	0.39	0.53	0.73	0.90	1.0

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CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

PHOTOMETRICS

CYL6630KMVDCPL

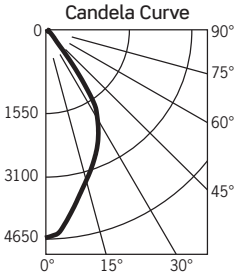
Fixture Delivered Lumens: 3423
Total Watts@120V: 43.0
Lumens Per Watt: 79.6
Center Beam Candle Power: 4582
Beam Distribution: 57°
Spacing Criterion: 0.80
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3033K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. 85318
LM-79 Test No. 85322

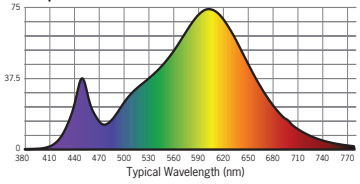
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	127.3	4.8
8'	71.6	6.4
10'	45.8	8.0
12'	31.8	9.6
14'	23.4	11.3
16'	17.9	12.9

Candela Curve



Spectral Power Distribution Chart[4]



CYL6630KMVDCXPB

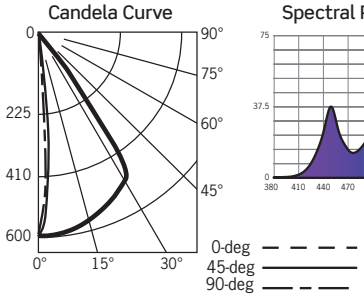
Fixture Delivered Lumens: 95
Total Watts@120V: 42.3
Lumens Per Watt: 2.2
Center Beam Candle Power: 614
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3033K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. G16122102
LM-79 Test No. 85322

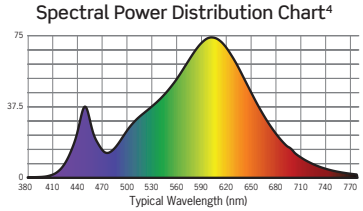
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	17.1	6.6 x 0.9
8'	9.6	8.8 x 1.2
10'	6.1	11.0 x 1.5
12'	4.3	13.2 x 1.7
14'	3.1	15.4 x 2.0
16'	2.4	17.6 x 2.4

Candela Curve



Spectral Power Distribution Chart[4]



CYL6630KMVDCWW

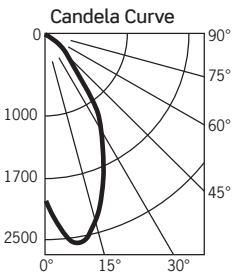
Fixture Delivered Lumens: 1827
Total Watts@120V: 42.4
Lumens Per Watt: 43.1
Center Beam Candle Power: 2024
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3033K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. G16122101
LM-79 Test No. 85322

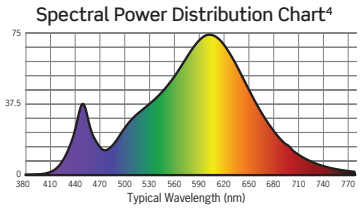
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	56.2	5.1 x 5.9
8'	31.6	6.8 x 7.9
10'	20.2	8.5 x 9.9
12'	14.1	10.2 x 11.9
14'	10.3	11.9 x 13.9
16'	7.9	13.7 x 15.9

Candela Curve



Spectral Power Distribution Chart[4]



1. Accuracy of rendering colors 2. Color appearance of light source 3. Dependent on surrounding temperatures 4. Colors present within the light source

PHOTOMETRIC MULTIPLICATION FACTORS

Lumen output values fluctuate based on CCT. To estimate lumen output of the various CCT/CRI options, multiply 3000K (80 CRI min) results by the following:

CCT	STD CRI	HIGH CRI	SERIES 1	SERIES 2	SERIES 3	SERIES 4	SERIES 5	WHT/PL REFLECT.
2700K	0.94	0.70	0.29	0.39	0.53	0.73	0.90	1.0
3000K	N/A	0.75	0.29	0.39	0.53	0.73	0.90	1.0
3500K	1.0	0.81	0.29	0.39	0.53	0.73	0.90	1.0
4000K	1.0	0.87	0.29	0.39	0.53	0.73	0.90	1.0

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CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

BUG RATINGS

Valid for all mountings except UD (Up/Down) or U (Up)

WATTAGE	REFLECTOR SELECTION					
	NARROW	MEDIUM	WIDE	PLATINUM	WALL WASH*	PENCIL BEAM
SERIES 1/10W	B1 U0 G0	B1 U0 G0	B1 U0 G1	B1 U0 G1	B0 U0 G0	B0 U0 G0
SERIES 2/14W	B1 U0 G0	B2 U0 G0	B2 U0 G0	B2 U0 G0	B0 U0 G0	B0 U0 G0
SERIES 3/20W	B1 U0 G0	B2 U0 G0	B2 U0 G0	B2 U0 G0	B0 U0 G0	B0 U0 G0
SERIES 4/28W	B1 U0 G0	B2 U0 G0	B2 U0 G0	B2 U0 G0	B0 U0 G0	B0 U0 G0
SERIES 5/37W	B2 U0 G0	B3 U0 G0	B3 U0 G1	B3 U0 G1	B1 U0 G0	B0 U0 G0
SERIES 6/43W	B2 U0 G0	B3 U0 G0	B3 U0 G1	B3 U0 G1	B1 U0 G0	B0 U0 G0

**WW rating based on reflector used as Forward Throw*

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DIMMING SPECIFICATIONS | 6" and 8" Cylinders: CYL6 Series, SQL6 Series and CYL8 Series

- Incandescent 120VAC dimmers adjust the light with "forward phase control," where the dimmer "chops" the forward part of the AC wave to deliver less or more power to the light source. No neutral wire connection required.
- Electronic vow voltage 120VAC dimmers adjust the light with "reverse phase control," where the dimmer "chops" the back part of the AC wave to deliver less or more power to the light source. Neutral wire connection required.
- 0-10V DC low voltage dimmers operate using two low voltage dimming wires that are separate from the 120V or 277V AC power. The dimmer sends a variable output voltage to the fixture based upon the dimming level. 10V corresponds to undimmed operation, 5V to 50% and so on. Switching on/off is controlled with the line voltage power (120V or 277V AC) input to the dimmer and then dimming operation is controlled with the 0-10V DC low voltage wiring connection between the dimmer and the LED driver. The control signal runs on two low voltage control wires (color coded violet and gray).
- Lutron HiLume and EcoSystem dirvers provide continuous dimming from 1%-100%. For a complete list of compatible dimmers and controls, please visit www.lutron.com
- Use DALI approved controls for dimming eldoLED MVD7 (1%-100%) and MVD9 (0.1%-100%) options.

			Driver Options 12D3, MVD	Driver Option MVD6	Driver Option MVD8
Manufacturer	Product	Model	Light Output	Light Output	Light Output
Leviton	IllumaTech	IPI06-1LZ	1%-100%	NA	NA
Leviton	SureSlide	6631-2	1%-100%	NA	NA
Leviton	Vizia	VPE06	9%-100%	NA	NA
Leviton	Trimatron	6683-IW	6%-100%	NA	NA
Leviton	Decora	6161	15%-100%	NA	NA
Leviton	SureSlide	6633-P	1%-100%	NA	NA
Leviton	IllumaTech	IPE04	6%-100%	NA	NA
Leviton	IllumaTech	IP710-DLX	NA	1%-100%	0.1%-100%
Cooper	Devine	DLC03P	1%-100%	NA	NA
Cooper	Skye	SLC03P	0%-100%	NA	NA
Cooper	Decorator	DAL06P	0%-100%	NA	NA
Pass & Seymour	Titan	CD4FB-W	NA	1%-100%	0.1%-100%
Synergy		ISD BC	NA	1%-100%	0.1%-100%
Watt Stopper	Miro Decorator	DCLV1	NA	1%-100%	0.1%-100%
Lutron	Ariadni	TGCL-153P	1%-100%	NA	NA
Lutron	Ariadni	TG-600P	13%-100%	NA	NA
Lutron	Diva	DVCL-153P	1%-100%	NA	NA
Lutron	Diva	DV600P	6%-100%	NA	NA
Lutron	Diva	DVELV303P	6%-100%	NA	NA
Lutron	Diva	DVTV	NA	1%-100%	0.1%-100%
Lutron	Faedra	FAELV500	12%-100%	NA	NA
Lutron	Lumea	LG600P	8%-100%	NA	NA
Lutron	Maestro	MAELV600	16%-100%	NA	NA
Lutron	Nova	NFTV	NA	1%-100%	0.1%-100%
Lutron	Nova T	NTFTV	NA	1%-100%	0.1%-100%
Lutron	Skylark	S-603PG	5%-96%	NA	NA
Lutron	Skylark	S600P	5%-100%	NA	NA
Lutron	Skylark	SELV300P	10%-100%	NA	NA
Lutron	Skylark	CT103P	9%-100%	NA	NA

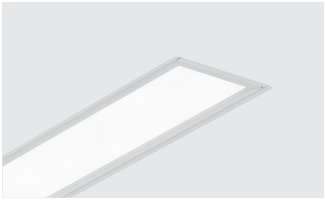
NOTES

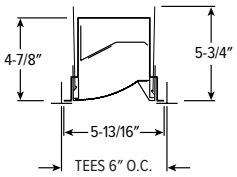
1. Testing was performed with a single fixture connected to dimmer.
2. Testing has been performed on these dimmers, but this does not imply any warranty of compatibility.
3. Dimming performance can be influenced by different loads, as well as variations in dimmer switches within the same model.
4. Dimmer maximum load rating with LED may differ from published traditional source dimmer ratings. Consult manufacturer for maximum dimmer information.
5. Consult factory for additional dimming information.

NOT USED

HETW LED Architectural Lensed Wall Wash

Williams





CATALOG #:

TYPE:

PROJECT:

FEATURES

- Attractive and efficient architectural fixture delivers comfortable, uniform perimeter illumination
- Frosted acrylic diffuser combined with highly reflective matte white paint provides visual comfort
- Multiple dimming protocols available
- Fully room-side accessible without the use of tools
- Quick-wire access plate in back of fixture housing for easy attachment of incoming power supply
- Made Right Here® in the USA

SPECIFICATIONS

- HOUSING – 22-gauge die-formed C.R.S.
- DOOR FRAME – Steel door frame with integral torsion springs to secure the frame within the fixture.
- SHIELDING – Frosted, ribbed acrylic.
- FINISH – Textured matte white polyester TGIC powder coat bonded to phosphate-free, multi-stage pretreated metal. All parts painted after fabrication to facilitate installation, increase efficiency, and inhibit corrosion.
- ELECTRICAL – High quality mid-power LED boards. Rated for 50,000 hours at 70% lumen maintenance (L70).
- MOUNTING – Designed for NEMA Type "G" 1" grid ceiling standard. For NEMA Type "NFG" and "SG" 9/16" grid installations, specify EQCLIPS option. Drywall kit accessories available for flange applications, shipped separately, see options. Fixture must be installed prior to Drywall Kit.
- LISTINGS –
  - cCSAus certified as luminaire suitable for dry or damp locations.
- WARRANTY – 5-year limited warranty, see hew.com/warranty.

ORDERING EXAMPLE: HETWG - 4 - L30/840 - A - OPTIONS - DIM - UNV

ORDERING INFO

SERIES	CEILING TYPE [1]	LENGTH	LUMENS [2]	CRI	CCT	SHIELDING [3]
HETW	**G** NEMA Type "G", "SS", and "NFG"	**2** 2′ **3** 3′ **4** 4′	**2′** **L16** 1,600lm **3′** **L24** 2,400lm **4′** **L30** 3,000lm	**8** 80 **9** 90 [4]	**30** 3000K **35** 3500K **40** 4000K **50** 5000K	**A** Curved frosted ribbed acrylic diffuser (standard) **A/CHA118** Curved frosted ribbed acrylic diffuser with clear, high temperature non-prismatic lens

OPTIONS		CONTROL [5]		VOLTAGE	
EM/10W	10-watt emergency battery	**DRV**	Non-dimming driver	**120**	120V
EQCLIPS	Earthquake clips [6]	**DIM**	Dimming driver	**277**	277V
(L__)	Additional lower lumen packages available. [7] **Example:** 2,500 nominal lumens = HETWG-4-L30/840-A-**(L25)**.			**UNV**	120-277V
DFK-0648W	Drywall kit, 6" x 48", white [8]			**347**	347V [9]

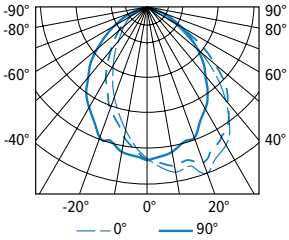
NOTES

1. When using in NEMA Type "SS" or "NFG" applications, must specify EQCLIPS option. For flange installations use the Drywall Kit (DFK), ordered separately, see page 3 for DRYWALL KIT (DFK) OPTIONS. Fixture must be installed prior to Drywall Kit.
2. Lumen output based on 3500 CCT with A shielding. Other shielding options may reduce lumen output. Actual lumens may vary +/-5%.
3. Other shielding options may reduce lumen output.
4. Extended lead times may apply. Consult factory for availability.
5. See page 2 for ADDITIONAL CONTROL OPTIONS.
6. 2 per fixture. Optional for 1" grid installations. Required for 9/16" grid mounting.
7. Specify in increments of 100 nominal lumens. Option must be specified with next higher lumen package.
8. Fixture must be installed prior to Drywall Kit (DFK). See page 3 for DRYWALL KIT (DFK) OPTIONS.
9. Not available with EM drivers.

HETW LED Architectural Lensed Wall Wash

PHOTOMETRY

HETWG-4-L30/840-A Report#: 16990.0 ; 12/13/12 | Total Luminaire Output: 3135 lumens; 43.2 Watts | Efficacy: 72.6 lm/W | 82.9 CRI; 3948K CCT



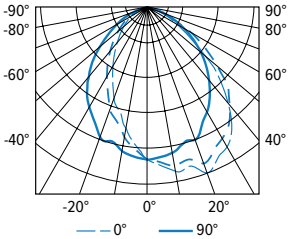
CANDLEPOWER DISTRIBUTION

VERTICAL ANGLE	HORIZONTAL ANGLE 0°	45°	90°	135°	180°	ZONAL LUMENS
0	1482	1482	1482	1482	1482	
5	1556	1518	1447	1386	1348	139
15	1599	1529	1347	1150	1059	380
25	1600	1512	1232	917	790	562
35	1409	1372	1040	686	565	641
45	984	1094	790	468	374	583
55	514	682	524	297	231	422
65	240	355	319	171	139	261
75	102	138	149	75	67	120
85	22	31	36	18	15	26
90	0	0	0	0	0	

LUMEN SUMMARY

ZONE	LUMENS	% FIXTURE
0 - 30	1081	35
0 - 40	1722	55
0 - 60	2728	87
0 - 90	3135	100
0 - 180	3135	100

HETWG-4-L30/840-A/CHA118 Report #: 16991.0 ; 12/13/12 | Total Luminaire Output: 2942 lumens; 42.8 Watts | Efficacy: 68.7 lm/W | 83.0 CRI; 3953K CCT



CANDLEPOWER DISTRIBUTION

VERTICAL ANGLE	HORIZONTAL ANGLE 0°	45°	90°	135°	180°	ZONAL LUMENS
0	1405	1405	1405	1405	1405	
5	1475	1440	1378	1320	1290	132
15	1513	1449	1282	1103	1019	362
25	1518	1433	1177	894	779	538
35	1340	1300	995	676	565	617
45	941	1034	758	468	385	564
55	479	631	494	298	239	400
65	203	304	285	161	134	231
75	67	96	111	59	52	86
85	11	14	15	10	10	12
90	0	0	0	0	0	

LUMEN SUMMARY

ZONE	LUMENS	% FIXTURE
0 - 30	1032	35
0 - 40	1649	56
0 - 60	2613	89
0 - 90	2942	100
0 - 180	2942	100

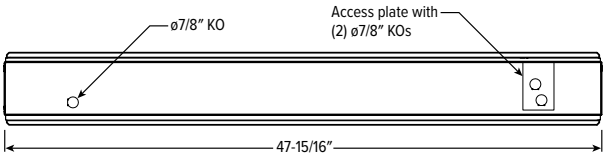
ADDITIONAL CONTROL OPTIONS

Note: Lumen restrictions apply, consult product builder at hew.com/product-builder.

CATALOG NUMBER	DESCRIPTION
DRV	Driver prewired for non-dimming applications
DIM	Dimming driver prewired for 0-10V low voltage applications
DIM1	1% dimming driver prewired for 0-10V low voltage applications
DIM LINE	Line voltage dimming driver (TRIAC and ELV compatible, 120V only)
DIM TRC	Line voltage dimming driver (TRIAC compatible, 120V only)
SD40	40% step-dimming driver
SD50	50% step-dimming driver
DALI	DALI dimming driver
LTE LINE	Lutron Hi-lume 1% 2-wire dimming driver forward phase line voltage controls (120V only)
LDE1	Lutron Hi-lume 1% EcoSystem dimming LED driver
ELDO SOLOB	EldoLED Solodrive, 0.1% dimming driver for 0-10V controls
ELDO SOLOB DALI	EldoLED Solodrive, 0.1% dimming driver for DALI controls
ELDO ECO1	EldoLED Ecodrive, 1% dimming driver for 0-10V controls
ELDO ECO1 DALI	EldoLED Ecodrive, 1% dimming driver for DALI controls

FIXTURE DETAILS

BACK VIEWS



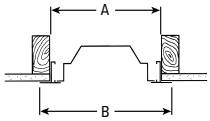
HETW LED Architectural Lensed Wall Wash

DRYWALL KIT (DFK) OPTIONS

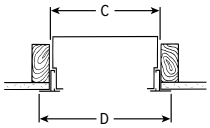
ORDERING EXAMPLE: DFK - 06 48 W			
SERIES	WIDTH	LENGTH	FINISH
DFK Drywall Kit	See table below	See table below	**W** White **AMW** Anti-microbial white

TYPICAL INSTALLATION

Refer to table for dimensions.



Width



Length

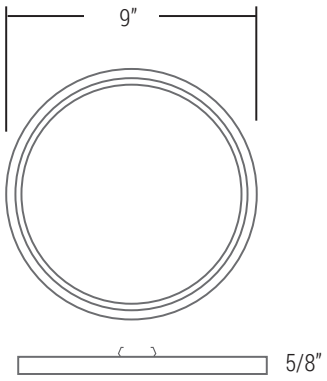
CATALOG NUMBER	NOMINAL SIZE	ROUGH-IN		FINISH TRIM SIZE	
		WIDTH (A)	LENGTH (C)	WIDTH (B)	LENGTH (D)
DFK-0648__	6" x 4'	6-3/8"	48-3/8"	7-5/16"	49-5/16"

elite LED LIGHTING

RL991

9 Inch Round LED Slim Surface Mount Dimmable Fixture

9″



FEATURES

The Elite LED Slim Surface Mount has been engineered to install into most standard junctionboxes. Up to 1200 usable lumens are directed from the luminaire to the work surface. Easy to install, applicable to junction box or recessed can installation.

LUMENS	1200
CCT	30K, 40K, 50K
CRI	90+
COLOR QUALITY	3-Step MacAdam Ellipse
DIMMING	DIMTR (Triac Dimming)
FINISH	WH (White), BK (Black), SN (Satin Nickel), BZ (Bronze)
LIFETIME	50,000 Hours

OPTICS

The Elite LED Module system is much more than just a simple LED retrofit. The Elite LED system is a highly engineered work of design and optical science which produces up to 1200 lumens. Our meticulously crafted optics gather the light scattered by the LED chip and shape it into a functional beam with uniform light distribution.

DIMMING

Intended for Triac (120V) based on configuration. Minimum 90ºC supply conductors.

COMPLIANCE

Non-conductive fixture for shower light application. Product complies with the requirements of the California Energy Commission regulated under Title 24.

LISTING

ETL listed for damp location (wet location - with covered ceilings)
Energy Star certified

WARRANTY

The Elite LED lighting system carries a five-year carefree warranty for parts and components. (Labor not included)

NOMINAL LUMENS	DELIVERED LUMENS	WATTAGE
1200	1515	19W

Based on 4000K, 90+ CRI. Actual wattage may vary +/- 5%

INSTALLATION

You MUST seal all gaps between the ceiling and fixture with weatherproof silicone sealant. This deters moisture and water from damaging fixtures and other mechanical ceiling elements.

EXAMPLE: **RL991-1200L-DIMTR-120-30K-90-WH**

TYPE	LUMEN	CCT	CRI	FINISH
RL991	❑ 1200L-DIMTR-120	❑ 30K ❑ 40K ❑ 50K	❑ 90+	❑ WH-White (standard) ❑ RL991-RT-BK - Black Ring ❑ RL991-RT-SN - Satin Nickel Ring ❑ RL991-RT-BZ - Bronze Ring

elite LED LIGHTING

RL991
9 Inch Round LED Slim Surface Mount Dimmable Fixture

9"

MOUNTING

Pancake J-Box (Metal)

3.5" Round (Plastic)

4" Square (Plastic)

4" Octagonal (Metal)

4" Square (Metal)

Fire Rated J-Box

Note: A 2-1/8" deep octagon junction box is recommended for through circuit wiring applications.

RING COLORS

RL991-RT-BK
Black

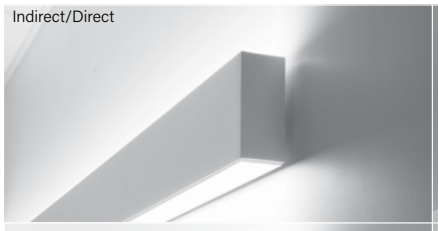
RL991-RT-SN
Satin Nickel

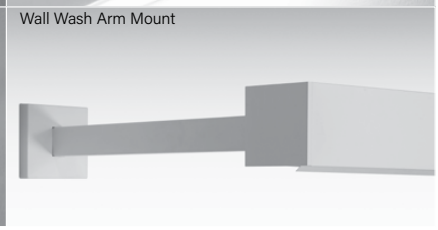
RL991-RT-BZ
Bronze

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount





High Performance 2" Aperture is a patented, linear LED luminaire family. HP-2 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

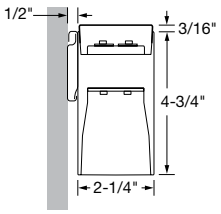
This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

Signal White is standard finish

Note: see page 6 for all aesthetic options

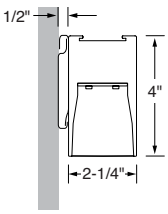
CROSS SECTIONS

Indirect/Direct
Top Glow Diffuser (standard)



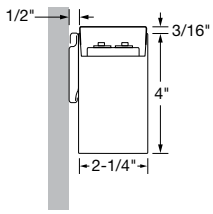
Flush Downlight Diffuser (standard)

Direct

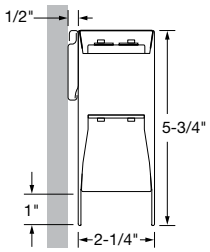


Flush Downlight Diffuser (standard)

Indirect
Top Glow Diffuser (standard)

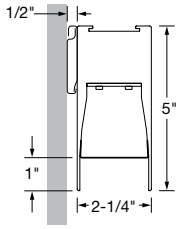


Indirect/Direct Regressed
Top Glow Diffuser (standard)



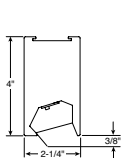
Flat Diffuser with 1" Regress (standard)

Direct Regressed

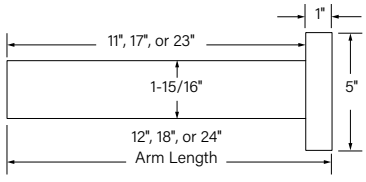


Flush Downlight Diffuser (standard)

Wall Wash Arm Mount



Kicker (standard)



ALSO AVAILABLE IN

Pendant (**D, ID, I**)

Recessed (**R**)

Surface Mount (**SM**)

Also available in Indigo-Clean. See Indigo-Clean Tech Sheet

A brand of legrand

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

Clear Form

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	◉ 2	◯ WM - Wall Mount [1] ◯ WM RG - Wall Mount Regressed [1] ◯ AM - Arm Mount	◯ D - Direct ◯ WW-D - Wall Wash Direct ◯ ID - Indirect/Direct ◯ I - Indirect	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT AND LED TYPE

Uplight Output ID & I Only (Flush)
◯ S - Standard (393 lm/ft) ◯ B - Boosted (494 lm/ft) ◯ H - High (747 lm/ft) ◯ V - Very High (961 lm/ft) ◯ TL - Tailored:_____lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

OUTPUT AND LED TYPE

Downlight Output ID & D Only (Flush)	LED CRI/CCT
◯ S - Standard (322 lm/ft) ◯ B - Boosted (405 lm/ft) ◯ H - High (612 lm/ft) ◯ V - Very High (786 lm/ft) ◯ TL - Tailored:_____lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of these range.	◯ 830 - 80 CRI, 3000K ◯ 835 - 80 CRI, 3500K ◯ 840 - 80 CRI, 4000K ◯ 930 - 90 CRI, 3000K ◯ 935 - 90 CRI, 3500K ◯ 940 - 90 CRI, 4000K ◯ 8TW - 80 CRI, Tunable White ◯ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Uplight	Downlight	Reflector System
◯ TG - Top Glow (standard) ◯ F - Flush ◯ ASY-L - Asymmetric Left Optic ◯ ASY-R - Asymmetric Right Optic ◯ ASYTG-L - Asymmetric Left Optic with Top Glow ◯ ASYTG-R - Asymmetric Right Optic with Top Glow	◯ F - Flush (standard) [1] ◯ BG - Bottom Glow [1] ◯ DL - 1" Drop Down Lens [2] ◯ RG-D - Flat Diffuser with 1" Regress [1,2] ◯ RG-WCB - White Cross Blade Baffle [1,2] ◯ RG-LHE - Hollowed Ellipse Louver [1,2] ◯ RG-LHC - Hex Louver [1,2] ◯ DAO-L - Downlight Asymmetric Optic Left [3] ◯ DAO-R - Downlight Asymmetric Optic Right [3] ◯ K - Kicker for Wall Wash only (standard) ◯ FO - Fully Open for Wall Wash only	◯ 96LG - 96 Low Gloss White ◯ SW - Signal White for Wall Wash only

ELECTRICAL OPTIONS

Voltage	Circuiting [4]	Driver Selection
◯ 120 - 120 Voltage ◯ 277 - 277 Voltage ◯ 347 - 347 Voltage	◯ SC - Single Circuit* One single circuit in a run ◯ DC - Dual Circuit* [5] Independent control of up and down separately in an I/D style fixture ◯ MC - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required * Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)	**0-10V Driver Options** ◯ FC-10% - 0-10V 10% [6] (standard) ◯ FC-1% - 0-10V 1% [6] ◯ OSR-10% - Osram OTi, 0-10V 10% [6] ◯ OSR-1% - Osram OTi, 0-10V 1% [6] ◯ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1% ◯ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [6] **DALI Driver Options** ◯ FC-DALI-1% - DALI 1% ◯ OSR-DALI-1% - Osram Dexal, 1% ◯ ELD-DALI-0% - EldoLED SOLOdrive, 0.1% ◯ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)* **DMX Driver Options** ◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [7] ◯ ELD-DMX - EldoLED POWERdrive, 0.1% ◯ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)* **Lutron Driver Options** ◯ LUT-ES1 - Lutron, Ecosystem 1% ◯ LUT-2W - Lutron, 2-wire (120V only) 1% ◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)* See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method	Endcap Style	Finish
◯ MB - Mounting Bracket [8] ◯ AM12 - 12" [9] ◯ AM18 - 18" [9] ◯ AM24 - 24" [9]	◯ FE - Flat Endcap (standard) ◯ DE - 1" Drop Endcap [10] ◯ OE - Open Endcap [11]	◯ SW - Signal White (standard) ◯ FB - Finelite Black [12] ◯ SA - Satin Aluminum [12] ◯ #### - RAL Color Code [12] _____

OTHER OPTIONS

Emergency Style (Optional)	Integrated Sensor (Optional)	Special Options (Optional)
◯ FAC CHO - Factory Choice Battery Back-up ◯ EM/GEN - Emergency to Generator ◯ NL - Night Light ◯ BSL310LP - Bodine Battery Back up Low Profile ◯ GTD - Generator Transfer Device	◯ OBO - Occupancy [1] ◯ OBD - Daylight [1] ◯ OBE - Enlighted [1,13] ◯ W601 - Wattstopper [14] Wireless Sensor ◯ REE - Remote Enlighted [15]	◯ RLA - Red List Approved ◯ RLD - Declared

[1] Not available for Wall Wash
[2] D & ID Regressed only
[3] Not available with regressed
[4] Contact factory for switching options
[5] Indirect/Direct only
[6] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[7] B & V outputs only
[8] Wall Mount only
[9] Arm Mount only
[10] 1" Drop Down Lens downlight only
[11] Available with Hollowed Ellipse Louver (**LHE**) only
[12] 20 business days lead time for color
[13] Enlighted components installed by Finelite, provided by others
[14] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.
[15] Enlighted for Wall Wash fixtures. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS[1]: Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, 1" Drop Down Lens[2], Regressed Diffuser, or White Cross Blade Baffle[3]. Corners not available with Wall Wash (**WW-D**), Hollowed Ellipse Louver (**LHE**) or Hex Louver (**LHC**). Contact factory for Double miters using the White Cross Blade Baffle. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

UPLIGHT OPTION[4]: Patented Top Glow frost white diffuser standard. 12' maximum diffuser length. 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination Optional: Flush frost white snap-in diffuser, 73% transmissive, 99% diffusion; **ASY-L** distributes light to the left, **ASY-R** distributed light to the right of the luminaire. Consult factory for more tailored lumen outputs.

DOWNLIGHT OPTION[5]: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), Bottom Glow (**BG**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**)[6], Hollowed Ellipse Louver (**LHE**)[6], Hex Louver (**LHC**)[6], Downlight Asymmetric Optic (**DAO**)[7], and Regressed downlight diffusers (**RG**). 1" Drop Down Lens made of highly efficient acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Asymmetric Optic is an extruded lens with a subtle ribbed appearance providing an asymmetric distribution for improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Wall Mount: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white power coat paint. **Arm Mount**: The standard Signal White (**SW**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL FEATURES

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed controlling uplight and downlight together (power and dimming). Specify dual feeds for independent control of uplight and downlight. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:
- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))
- **LUT-2W (LTEA2W)** - (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime.:** 100,000 hours
- **FineTune DMX:** 1%

[1] Not available with Wall Wash
[2] Indirect/Direct and Direct only
[3] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[4] Wall Mount Indirect/Direct, Wall Mount Regressed Indirect/Direct, and Wall Mount Indirect only
[5] Wall Mount Indirect/Direct, Wall Mount Regressed Indirect/Direct, Wall Mount Direct, and Wall Mount Regressed Direct only
[6] Wall Mount Regressed Indirect/Direct & Wall Mount Regressed Direct only
[7] Not available with Regressed

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SPECIFICATIONS

LUTRON TUNABLE WHITE DRIVER OPTION: LUT-TW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE: Wall Mount: Luminaire hangs securely from mounting brackets fastened directly to the wall for easy installation. Luminaire stands 1/2" off the wall. The mounting bracket is concealed behind the luminaire. **Arm Mount**: bracket mounts directly to wall j-box, extends luminaire 12", 18", or 24" from wall. Other lengths available. Consult factory.

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of luminaire runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER OPTIONS

ENDCAPS: Flat diecast aluminum endcaps (**FE**) add 1/4" to each end of luminaire. 1" Drop Down Lens Endcap (**DE**)[8] includes diffuse element to continue luminance of drop lens. Open Endcap (**OE**) is for use with the Hollowed Ellipse Louver (**LHE**); following the curve of the louver.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery. Factory choice low-profile backup battery available. 8' minimum luminaire length for low profile battery pack.
- **Indirect/Direct:** backup batteries deliver 1608 lumens. 12' minimum luminaire length. 2' illuminated (downlight standard).
- **Direct:** backup batteries deliver 1608 lumens. 8' minimum luminaire length. 2' illuminated.
- **Indirect:** backup batteries deliver 1874 lumens. 8' minimum luminaire length. 2' illuminated.
- **Wall Wash:** backup batteries deliver 1500 lumens. 8' minimum luminaire length. 2' illuminated.

Tunable White ELECTRICAL OPTIONS[9]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) occupancy or daylight sensors available with Flush and Bottom Glow downlight diffusers. Refer to Occupancy Sensor, Daylight Sensor, and Enlighted Sensor tech sheets for more info.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**)[10], and Satin Aluminum (**SA**)[10] are standard. Optional Adder: 185 RAL colors[10] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These fixtures are rated for Damp Location. HP-2 can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT[11]: ID - 2.9 lb/ft; D - 2.3 lb/ft; I - 2.3 lb/ft; AM - 2.9 lb/ft (luminaire only)

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

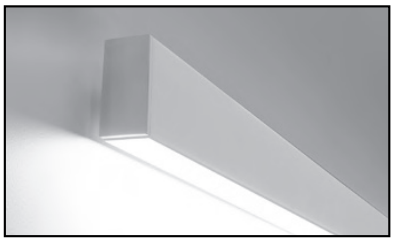
[8] Available in Indirect/Direct Regressed & Direct Regressed only
[9] Consult Finelite for Generator Transfer Device and Battery Back up fit
[10] 20 business days lead time for color
[11] Excludes Battery Back up and Generator Transfer Device weight

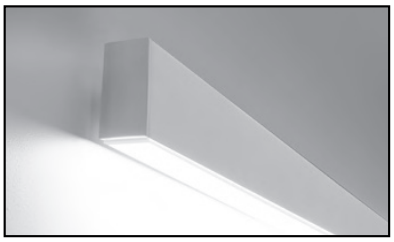
Submitted by:	Date:
Type:	Project:
Ordering Info:	

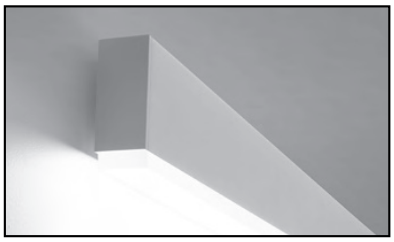
FINELITE® Better Lighting

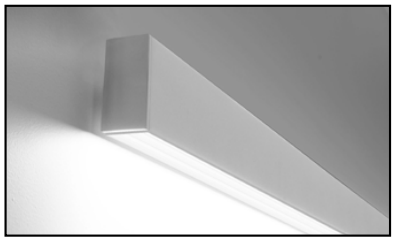
High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

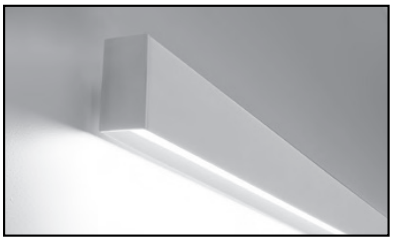
AESTHETIC OPTIONS

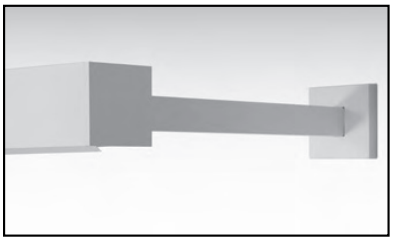

Flush Diffuser (**F**)

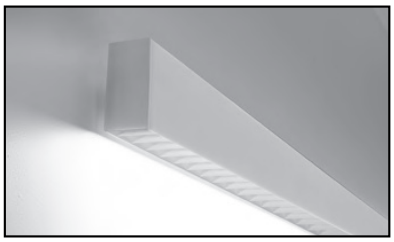

Bottom Glow Diffuser (**BG**)

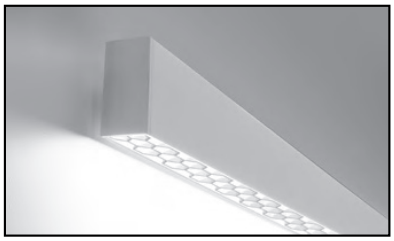

1" Drop Down Lens (**DL**)

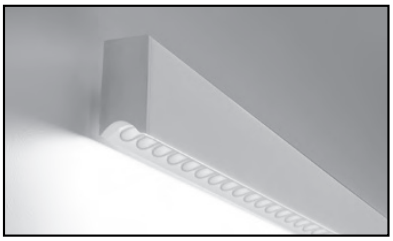

Downlight Asymmetric Optic (**DAO**)[1]
Externally flush


Flat Diffuser with 1" Regressed (**RG-D**)


Kicker (**K**) - Wall Wash Arm Mount only


White Cross Blade Baffle[2] (**RG-WCB**)


Hex Louver[2] (**RG-LHC**)


Hollowed Ellipse Louver[2] (**RG-LHE**)

[1] With a subtle ribbed appearance providing an asymmetric distribution
[2] Regressed only

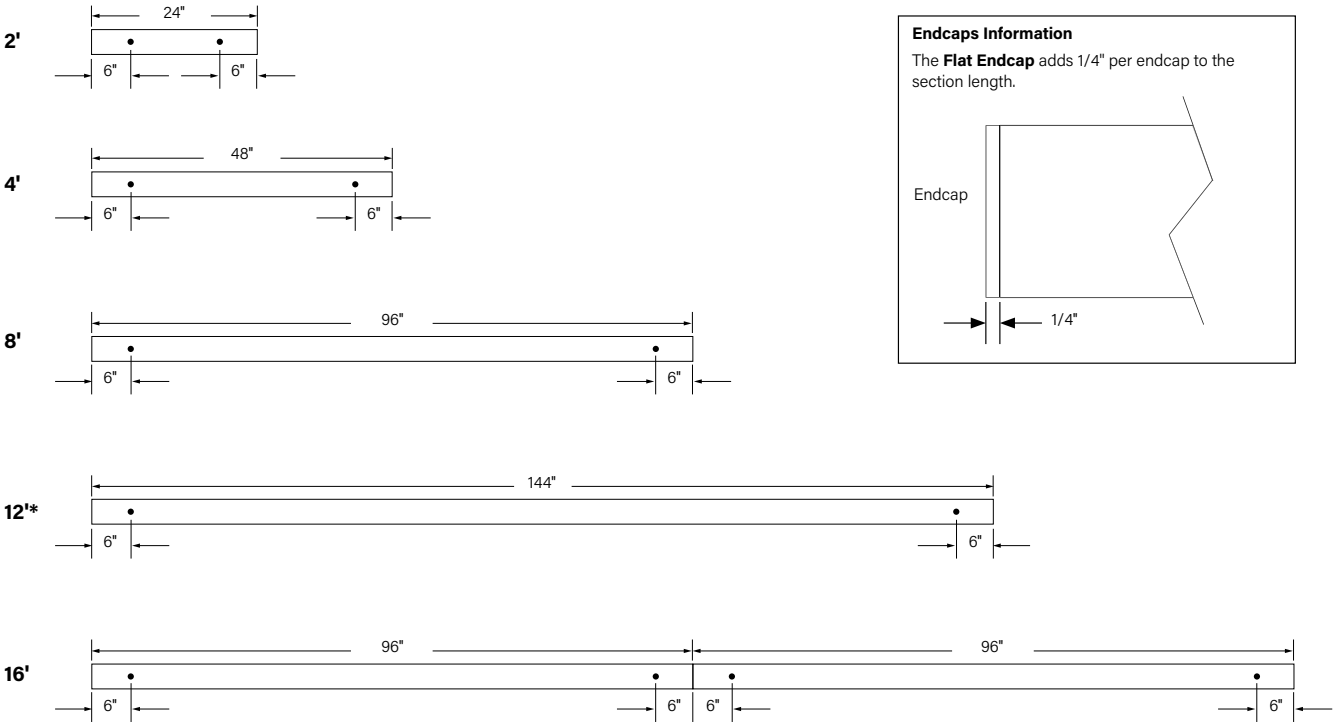
Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

WALL WASH ARM MOUNT - Run Lengths & Mounting Location Examples

Tailored Lengths Available Down To 1/16" (±1/32")



Endcaps Information

The **Flat Endcap** adds 1/4" per endcap to the section length.

• = Bracket Location
* = 12' Maximum spacing for two Arm Mount supports

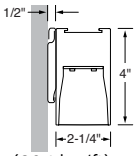
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

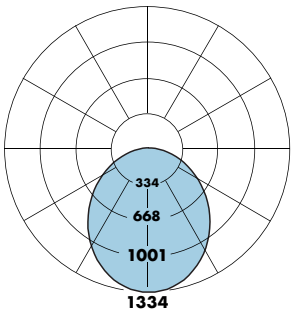
High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

Direct Photometry - 4' Luminaire 3500K

HP2-WM-D-4'-V-835
Downlight: Flush Diffuser



Efficacy: 87 lm/W
Total luminaire output: 3215 lumens (804 lm/ft)
36.9 watts (9.2 W/ft)
Peak Candela Value: 1334 @ 0º
CRI: 80 / CCT: 3500K
ITL LM79 Report 85136



CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	FLUX
0	1334	1334	1334	1334	1334	
5	1327	1326	1326	1325	1324	126
15	1236	1252	1251	1244	1236	352
25	1133	1117	1109	1088	1075	508
35	958	942	923	896	887	576
45	762	747	725	697	686	558
55	563	551	532	509	500	475
65	374	365	351	337	331	349
75	206	201	195	188	184	207
85	62	61	59	57	57	66
90	0	0	0	0	0	

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B [1]**	**H [1]**	**V [2]**
1316	1655	2501	3215

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
329	414	625	804

Power, 3500K (Watts Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
3.6	4.6	7.1	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B [1]**	**H [1]**	**V [2]**
91	90	88	87

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 2501 lm x 0.789 = 1973 lm

Total Light Output per Foot: 625 lm/ft x 0.789 = 493 lm/ft.

watts/foot: 7.1 W/ft.

$$\textbf{Efficacy} = \frac{493\ \frac{\text{lm}}{\text{ft.}}}{7.1\ \frac{\text{W}}{\text{ft.}}} = 69\ \text{lm/W}$$

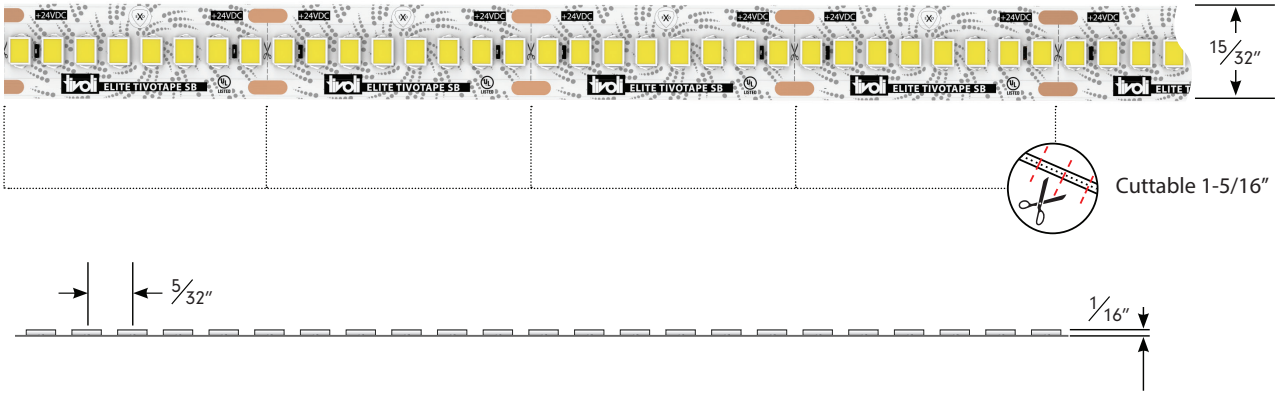
S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85136

ELITE | TivoTape™ Indoor (factory installed power lead wires)

Standard Brightness (SB)

PENDING PATENTED PENDING



3.2W/ft
355LM/ft

4oz. Trace

111 EFFICACY LEVEL
High Efficacy

HIGH CRI
95 CRI

JA8 CA24
Compliant

3M
VHB Adhesive

IP54

eXo
eXo Shield

2200K | 2400K | 2700K | 3000K | 3500K | 4000K | 5000K

Ordering Information

c UL us LISTED

PRODUCT CODE		INTENSITY		INSTALL		LED COLOR		VOLTAGE
TPLE	-	SB	-	I	-		-	24

TPLE = TivoTape ELITE

SB = Standard Brightness

I = Indoor

LED COLOR

- **22** = 2200K
- **24** = 2400K
- **27** = 2700K
- **30** = *3000K
- **35** = 3500K
- **40** = 4000K
- **50** = 5000K

24 = 24V DC

TivoTape Run Lengths & End Preps
Please specify length of run with quantity of run(s) and end prep type at time of ordering.
Note: Only (1) end prep needed for each run (see page 19)

*This product is in compliance with the California Energy Code Title 24 JA8-2016 in 3000K and only when incorporating a specific power supply.

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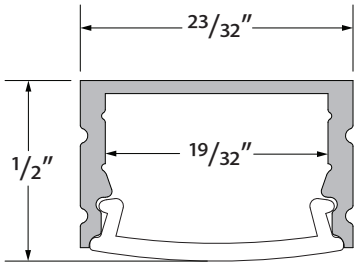
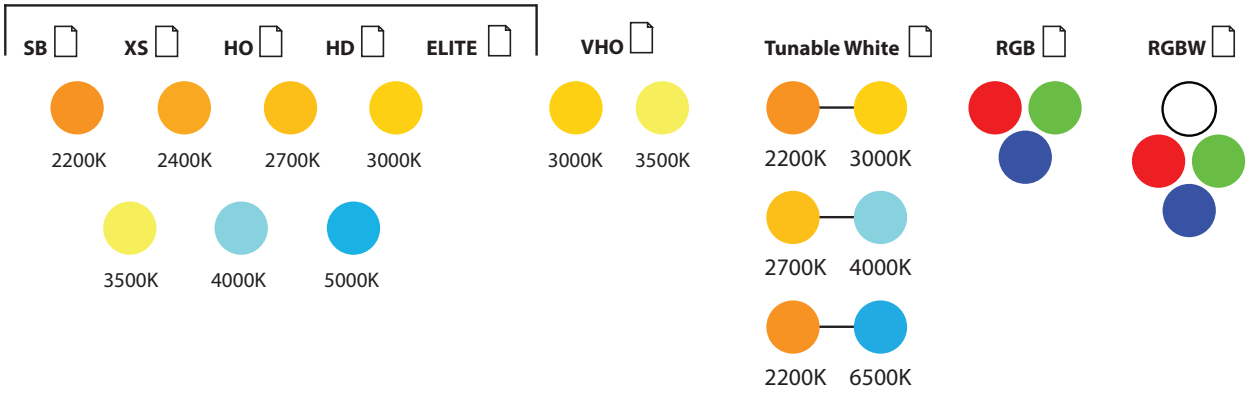
PROFILE DIMENSIONS



AVAILABLE TIVOTAPE™ OPTIONS



ORDERING INFORMATION

MOFT-CHAN-SLV-6.5
Anodized Aluminum Extrusion, available in 6.5' lengths

MOFT-LNS-OPL-6.5
Lens, opal, length 6.5'

MOFT-LNS-CLR-6.5
Lens, clear, length 6.5'

MOFT-LNS-DIF-6.5
Lens, diffuser, length 6.5'

MOFT-EC-01
Solid End Cap

MOFT-EC-02
Powerfeed End Cap

MOFT-CLP-SLV
Clip, Metal

Tivoli, LLC. reserves the right to modify this specification without prior notice.

www.tivolilighting.com tel: 714-957-6101 fax: 714-427-3458

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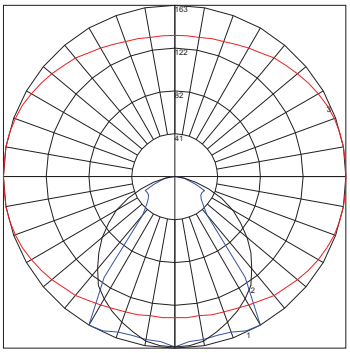
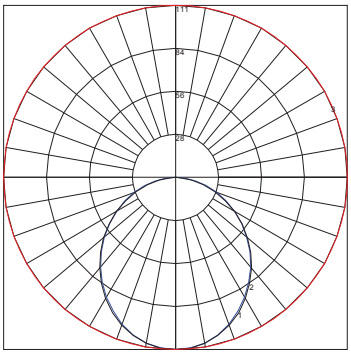
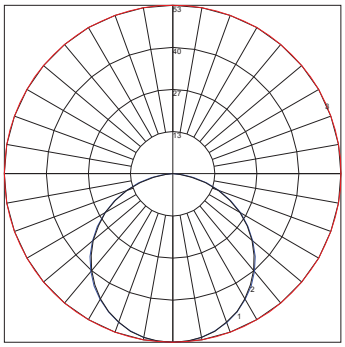
PHOTOMETRICS BASED ON 3000K/HO/ELITE TIVOTAPE



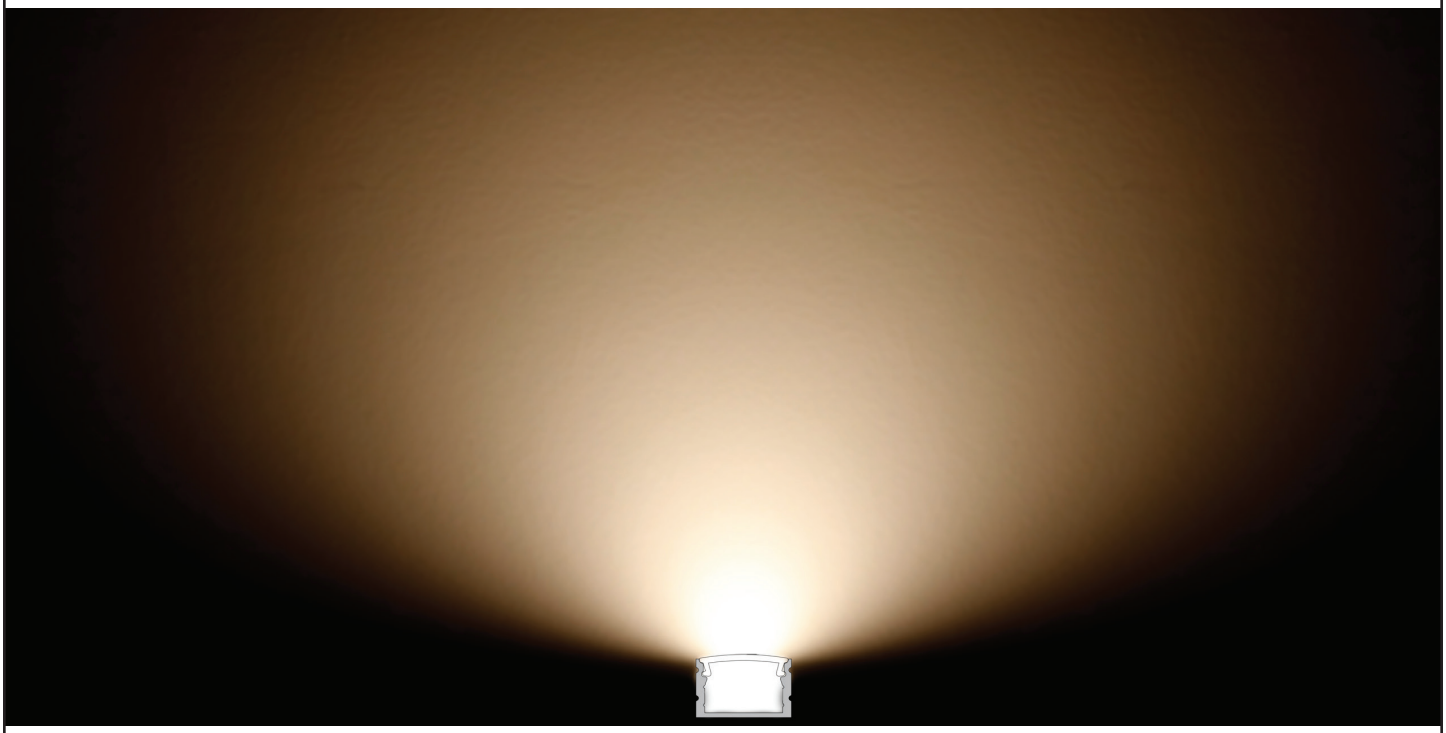
MOFETT WITH CLEAR LENS
Lumens per foot: 364.83
Watts per foot: 4
CRI : 94.8
Peak Candela: 163



MOFETT WITH DIFFUSED LENS
Lumens per foot: 299.44
Watts per foot: 4
CRI : 95.4
Peak Candela: 111.34



MOFETT WITH OPAL LENS
Lumens per foot: 157.34
Watts per foot: 4
CRI : 97.6
Peak Candela: 53.14



KURV-SW-HE

Q-CAP Flexible Fixtures

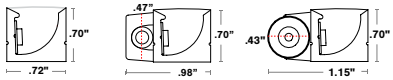
KURV-SW-HE is a fully encapsulated flexible linear LED fixture suitable for use in direct viewing applications because diodes are not visible due to its unique shape. KURV has a built-in parabolic curve, which allows the fixture to push out asymmetrical light with its internal reflector. Because of its dry and wet rating, it is perfect for not only indoor use but also as outdoor accent lighting, especially when the light needs to be wrapped around a mass. KURV-SW-HE encapsulates our one step, one bin 24-volt static white high efficacy LED strips in polyurethane. It is offered in three different outputs: standard output (1.5W/ft), high output (3.0W/ft), and very high output (6.0W/ft). Available in a clear finish, where diodes are visible, or a translucent finish, where light is diffused.

Output [Calculated L70 = 35000 hours]

Tested for KURV-SW-HE-WSC-DRY

	SO Standard Output **1.5 W/ft**				**HO** High Output **3.0 W/ft**				**VHO** Very High Output **6.0 W/ft**			
	ENC/CL		**ENC/TL**		**ENC/CL**		**ENC/TL**		**ENC/CL**		**ENC/TL**	
CCT	**LM**	**CRI**	**LM**	**CRI**	**LM**	**CRI**	**LM**	**CRI**	**LM**	**CRI**	**LM**	**CRI**
2400K	133	93	133	92	272	93	270	92	465	93	460	92
2700K	153	95	146	95	282	96	264	96	493	96	468	96
3000K	150	96	163	96	311	96	295	96	529	97	515	96
3500K	159	98	144	98	295	98	295	98	556	98	486	98
4000K	147	97	127	97	298	97	258	97	518	97	445	97

Dimensions



Profile (Standard) | Profile (Seamless bare wire) | Profile (Seamless barrel)

Wiring Detail

2" increments from 2"-191"

Part Number Builder

Product	Mounting	Rated	CCT	Output	Lens	Type	Connector/ Wire in	Connector/ Wire out	End Caps (No feed)	Length (in)
KURV-SW-HE										

Voltage: 24 VDC
Wattage: see table

*White snug clip included with side graze channel

ENCAPSULATED PRODUCTS ARE **NOT** FIELD CUTTABLE

Mounting: **WSC**, **RLC**, **MC**, *SGC, **PPS-2**, **PPS-96**, **PPS-FT**, **PPS-LP-2**, **PPS-LP-96**, **PPS-LP-FT**

Rated: **DRY** (IP20); **WET** (IP67)

CCT: **24** - 2400K; **27** - 2700K; **30** - 3000K; **35** - 3500K; **40** - 4000K

Output: **SO** (1.5W); **HO** (3.0W); **VHO** (6.0W)

Lens: **ENC/CL**, **ENC/TL**

Type: Single (Closed exit): **S1**, **S2**, **S3**, **S4**, **S5**, **S6**; Pass through: **P1**, **P2**, **P3**, **P4**, **P5**, **P6**

Connector/ Wire in: **BW**, **BRL**

Connector/ Wire out: **N/A**, **BW**, **BRL**

End Caps (No feed): **CL**, **WH**, **N/A**

Length (in):

- **BW** comes in standard 24"- request custom length (Max 120") by writing it in inches next to "BW" in the order code box (ex. BW48)
- **Connector/Wire In or Out** not needed to specify product. Standard configuration is type S1, Connector/Wire In: BW & Connector/Wire Out: N/A with white endcap (WH)
- **PPS** mounting clip recommended for seamless applications

Flexibility

- 5 year warranty
- Field modifications are not covered under Q-Tran warranty
- Side Bend
- IK10 impact rated
- Data subject to change, all data has +/- 5% tolerance
- **PPS-FT** is to be cut at Q-Tran to requested length

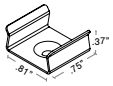
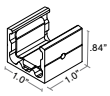
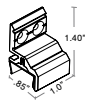
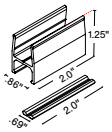
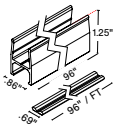
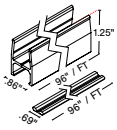
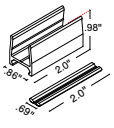
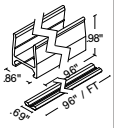
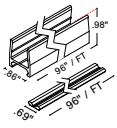
Specification subject to change. Rev-06-10-21

KURV-SW-HE

Q-CAP Flexible Fixtures

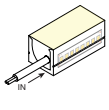
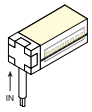
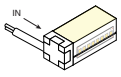
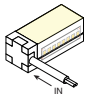
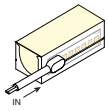
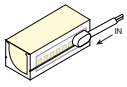
Mounting

NOTE: 2 white snug clips provided per first 12", 1 for each additional 12". Other mounting styles incur additional charge, see price guide for details.

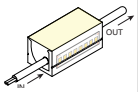
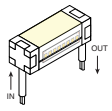
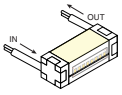
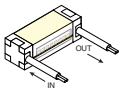
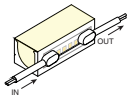
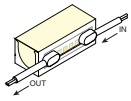
WSC	RLC	MC	SGC	PPS-2	PPS-96	PPS-FT	PPS-LP-2	PPS-LP-96	PPS-LP-FT
									
White snug clip	Rigid lock channel	Magnetic clip (Cove use only)	Side graze channel	PVC mounting clip		PVC channel Custom length	Low profile PVC mounting clip	Low profile PVC channel	Low profile PVC channel Custom length

Type

SINGLE (Input only)

S1	S2	S3	S4	S5	S6
					
				Seamless	Seamless

PASS THROUGH (Input/Output)

P1	P2	P3	P4	P5	P6
					
				Seamless	Seamless

End Caps (No Feed)

CL	WH
	
Clear endcaps .0" added at end	White endcaps .0" added at end
.00" dim spot	.10" dim spot

End Caps (With Feed)

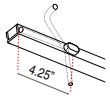
End Feed	Tri-Directional
S1, P1	S2, S3, S4, P2, P3, P4
	
White endcaps .0" added at end	White endcaps .32" added at end
.10" dim spot	.67" dim spot

Bend Radius

Side bend
6" bending radius

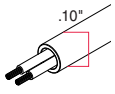
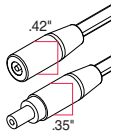
Seamless

Shown with bare wire, connectors vary



Omnidirectional wireways
S5, P5, S6, P6

Connector/Wire – In/Out

BW	BRL
	
Bare Wire 24"	Barrel 6"

Lens with LED visibility

ENC/CL	ENC/TL
	
Encapsulated in clear	Encapsulated in translucent

Compatible Power Supplies

See website for additional power supply options

QTM-DC+CAP	iQ-PH-80 QD1	QZ	QTM-eLED
			

Specification subject to change. Rev-06-10-21

CONTECH LIGHTING | a LEVITON company

CATALOG NO.

DATE PROJECT TYPE

CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

	CYL61	CYL62	CYL63	CYL64	CYL65	CYL66
WATTAGE	10W	14W	20W	28W	37W	43W
LUMEN OUTPUT[1]	1000Lm	1400Lm	2000Lm	2600Lm	3200Lm	3600Lm
COLOR TEMPERATURE	2700K, 3000K, 3500K, 4000K					
CRI	83 (80min) / 90+					
SYSTEM RATING	50,000 Hours @ 70% Lumen Maintenance					
REFLECTORS	36° Narrow Clear, 54° Medium Clear, 57° Medium Platinum, 80° Wide Clear, Wall Wash, Pencil Beam					
MOUNTING	Ceiling, Flexible Cable Pendant with Canopy, Rigid Stem Pendant with Canopy, Flexible Cable Pendant with Track Adapter, Wall Mount Up Light or Down Light, Up/Down Wall Mount					
DRIVER INPUT WATTAGE	10W	14W	20W	28W	37W	43W
DRIVER INPUT CURRENT (A) 120V/277V	.08/.04	.12/.06	.17/.08	.23/.11	.31/.14	.36/.17
DRIVER POWER FACTOR	> 0.90					
THD	< 20%					
LISTING	cCSAus Certified for use in the U.S. and Canada. Ceiling, Rigid Stem Pendant, Up/down, and Wall mount models available as Damp/Dry or Wet location models. Flexible Cable Pendant Mount only available as Damp/Dry location model. ENERGY STAR® Certified for all Mounting Options except Up/Down Wall Mount ENERGY STAR® Certified for all Reflector Options except Pencil Beam and Wall Wash Reflectors					
WARRANTY	Five (5) year replacement after date of purchase					

1. Lumen values are approximate, see photometric test results

Ceiling Mount

Flexible Cable Pendant Mount

Rigid Stem Pendant Mount

Flexible Cable Pendant with Track Adapter

Wall Mount Down Light

Wall Mount Up Light

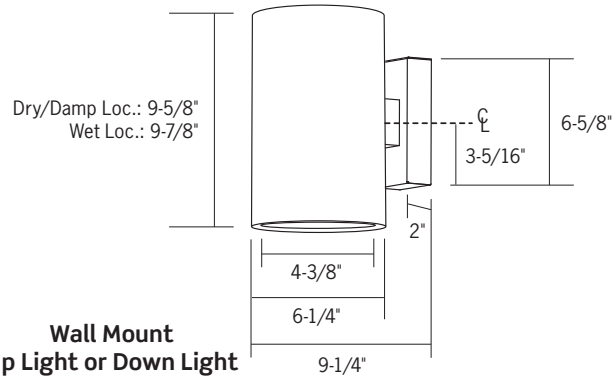
Up/Down Wall Mount

CONTECH LIGHTING | a LEVITON company

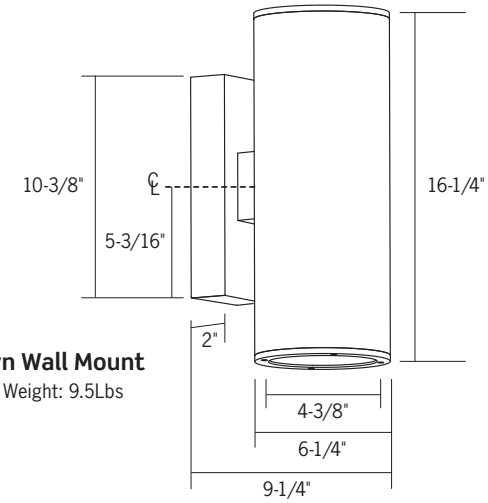
CATALOG NO.

DATE PROJECT TYPE

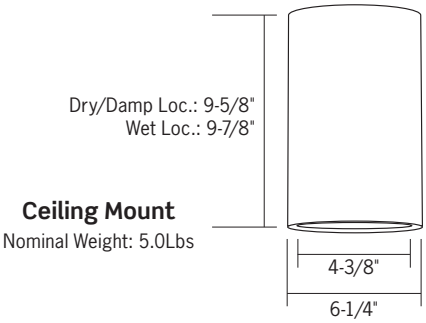
CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders



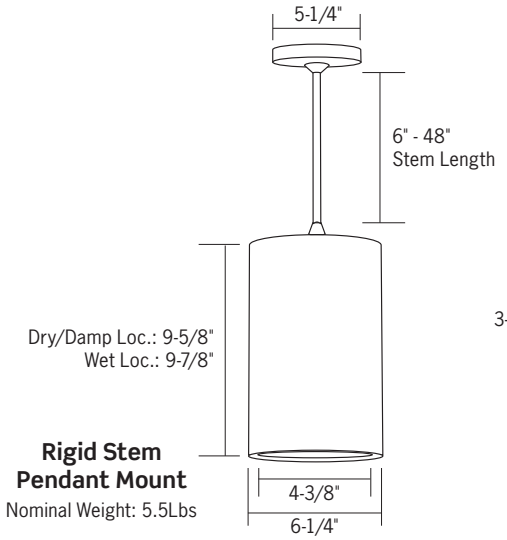
Wall Mount
Up Light or Down Light
Nominal Weight: 6.0Lbs



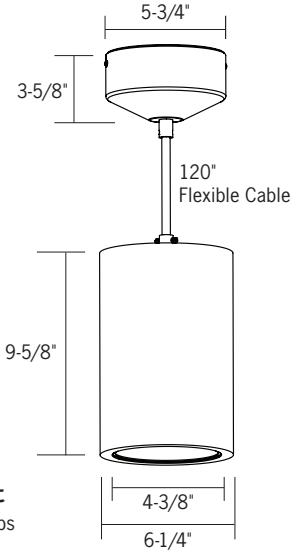
Up/Down Wall Mount
Nominal Weight: 9.5Lbs



Ceiling Mount
Nominal Weight: 5.0Lbs



Rigid Stem
Pendant Mount
Nominal Weight: 5.5Lbs



Flexible Cable
Pendant Mount
Nominal Weight: 6.0Lbs

CONTECH LIGHTING | a LEVITON company

CATALOG NO.

DATE PROJECT TYPE

CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

ORDERING INFORMATION

Example Order: CYL6127KMVD4FCXNCLR — BZ

Luminaire/ LED Series
- **CYL61** - 10W/ 1000lm
- **CYL62** - 14W/ 1400lm
- **CYL63** - 20W/ 2000lm
- **CYL64** - 28W/ 2600lm
- **CYL65** - 37W/ 3200lm
- **CYL66** - 43W/ 3600lm

Color Temp/CRI

83 (80min) CRI
- **27K** - 2700K
- **30K** - 3000K
- **35K** - 3500K
- **40K** - 4000K

90+ CRI
- **27KC** - 2700K
- **30KC** - 3000K
- **35KC** - 3500K
- **40KC** - 4000K

Driver/Dimming
- **MVD** - 120V-277V TRIAC, ELV, 0-10V Dimming
- **34D2** - 347V, 0-10V Dimming
- **12D3** - Lutron Hi-lume 1% 2-Wire LED Driver (120V Forward Phase Only)
- **MVD4** - Lutron Hi-lume 1% EcoSystem LED Driver with Soft-on, Fade-to-Black
- **MVD6** - eldoLED ECOdrive 0-10V, 1% Dimming
- **MVD7** - eldoLED ECOdrive DALI, 1% Dimming
- **MVD8** - eldoLed SOLOdrive 0-10V, 0.1% Dimming
- **MVD9** - eldoLED SOLOdrive DALI, 0.1% Dimming
- **MDMX** - eldoLED POWERdrive DMX <1% Dimming

Mounting
- **C** - Ceiling Mount
- **FC**[1] - Flexible Cable Pendant Mount
- **P**[2] - Rigid Stem Pendant Mount
- **W** - Down Light Wall Mount
- **U** - Up Light Wall Mount
- **UD**[3] - Up/Down Wall Mount
- **TFC**[4] - Flexible Cable Pendant with Track Mount Adapter

Mntg Location
- - Interior Dry/Damp Locations, Leave Blank
- **X** - Exterior/Wet Locations

Reflector
- **NCLR** - 36° Narrow, Clear Alzak
- **MCLR** - 54° Medium, Clear Alzak
- **WCLR** - 80° Wide, Clear Alzak
- **PL** - 57° Medium, Platinum
- **WW**[5] - Wall Wash
- **PB**[5,6] - Pencil Beam

—

Finish
- **B** - Matte Black
- **BZ** - Satin Bronze
- **P** - Matte White
- **S** - Matte Silver
- **CC**[7] - Custom Color

—

Battery and Remote Enclosure
- - None, Leave Blank
- **RDB**[8] - Remote Driver & Battery Pack
- **RD** - Remote Driver Enclosure

Stems for Rigid Stem Pendant Mount (P)

Rigid Stem Pendant Mount Option includes a Slope Ceiling Canopy and 6-inch Stem. Extra stem lengths must be ordered separately as needed. Maximum Stem Length: 8 Ft. 6-inches; consult factory for longer lengths.
- **6" STEM(A)** - 6" Stem
- **12" STEM(A)** - 12" Stem
- **18" STEM(A)** - 18" Stem
- **24" STEM(A)** - 24" Stem
- **30" STEM(A)** - 30" Stem
- **36" STEM(A)** - 36" Stem
- **48" STEM(A)** - 48" Stem
- **COUPLING** - Stem Coupling

—

Finish
- **B** - Matte Black
- **BZ** - Satin Bronze
- **P** - Matte White
- **S** - Matte Silver
- **CC**[7] - Custom Color

1. *Flexible Cable Pendant Mount Versions are only available in Dry/Damp location type.*
2. *Rigid Stem Pendant Mount includes Slope Ceiling Canopy (up to 45°) and 6-inch Stem; extra stem lengths must be ordered separately as needed. Maximum Suspension Length: 8 Ft. 6-inches; consult factory for longer lengths.*
3. *Consult factory when different beams, color temperatures, or lumen packages are required in a single Up/Down Cylinder.*
4. *Flexible Cable Pendant with Track Adapter option is only available with MVD Driver wired to 120V; TRIAC/ELV Dimming capable. Satin Bronze (BZ) Finish comes with Black Track Adapter.*
5. *Wall Wash (WW) and Pencil Beam (PB) valid on all models except Up/Down Cylinder with Series 5 or 6 LED Module (leave reflector designation blank)*
6. *Pencil Beam (PB) optic limited to exterior mount ("X") location style*
7. *Custom finish colors available. Consult factory for pricing, minimum order quantities and lead time.*
8. *Consult factory for RDB options on Up/Down (UD) luminaires. RDB Option only available with MVD driver. RDB Enclosure must be installed in a Dry/Damp Location.*

CONTECH LIGHTING | a LEVITON company

CATALOG NO.

DATE PROJECT TYPE

CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

DRIVER AVAILABILITY MATRIX

Highest wattage for each driver style that will fit inside the luminaire

DRIVER*:	MVD 120V-277V TRIAC, ELV	12D3 Lutron Hi-lume	MVD4 Lutron EcoSystem	MVD6 eldoLED ECODrive	MVD7 eldoLED ECODrive	MVD8 eldoLED SOLODrive	MVD9 eldoLED SOLODrive	MDMX eldoLED POWERdrive	34D2 347V 0-10V
MOUNTING									
CEILING	All Series	All Series	All Series	Thru Series 5	Thru Series 5	Thru Series 5	Thru Series 5	N/A	All Series
FLEX CABLE	All Series	All Series	All Series	Thru Series 5	Thru Series 5	Thru Series 5	Thru Series 5	N/A	All Series
RIGID STEM	All Series	All Series	All Series	Thru Series 5	Thru Series 5	Thru Series 5	Thru Series 5	N/A	All Series
DOWN LIGHT	All Series	All Series	All Series	All Series	All Series	All Series	All Series	All Series	All Series
UP LIGHT	All Series	All Series	All Series	All Series	All Series	All Series	All Series	All Series	All Series
UP/DOWN	All Series	All Series	All Series	Thru Series 5	Thru Series 5	Thru Series 5	Thru Series 5	N/A	All Series
TRACK MOUNT	All Series	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**Driver sizes that do not fit in fixture may be ordered with a Remote Driver Housing (-RD)*

	CYL61	CYL62	CYL63	CYL64	CYL65	CYL66
DRIVER INPUT WATTAGE	10W	14W	20W	28W	37W	43W
DRIVER INPUT CURRENT (A) 120V/277V	.08/.04	.12/.06	.17/.08	.23/.11	.31/.14	.36/.17
DRIVER INPUT VOLTAGE						
Triac, ELV, 0-10V	120V AC, 50/60Hz 277V AC, 50/60Hz					
Lutron HiLume® Dimming	120V AC, 50/60Hz					
Lutron Eco-System® Dimming	120V AC, 50/60Hz 277V AC, 50/60Hz					
eldoLED ECOdrive/SOLOdrive	120V AC, 50/60Hz 277V AC, 50/60Hz					
DRIVER POWER FACTOR	> 0.90					
THD	< 20%					
DIMMING						
Triac, ELV, 0-10V	10-100%					
Lutron® Dimming	1-100%					
eldoLED ECOdrive	1-100%					
eldoLED SOLOdrive	0.1-100%					

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CATALOG NO.

DATE PROJECT TYPE

CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

PRODUCT DETAILS

Construction

- Specification grade 6" diameter aluminum housing for indoor and outdoor applications
- Driver canopy for flexible cable option is 16 gauge steel
- Ceiling, Pendant, Up/down, Wall Mount Down Light, and Wall Mount Up Light models are available in either Dry/Damp (Indoor) or Wet (Outdoor) Location types. Flexible Cable versions are only available in Dry/Damp Location type.
- Wet Location type cylinders feature a silicone sealed clear glass lens in a gasketed die-cast trim ring to ensure unit is watertight
- Available in Matte White, Matte Black, Matte Silver and Satin Bronze finishes. Black Flexible Cable with Black or Bronze Cylinders, White with White and Gray with Silver.
- Custom finish colors available. Consult factory for pricing, minimum order quantities and lead time.
- UL8750 and Class 2 compliant: RoHS compliant, U.S. only.
- Output over voltage, over current and short circuit protected.

Features

- Ceiling and Pendant Cylinders provide a hang support for hands-free wiring
- Wall Mount Cylinders employ a bracket which provides support for hands-free wiring
- Rigid Stem Pendant Mount Option includes a Slope Ceiling Canopy (up to 45°) and 6-inch Stem. Extra stem lengths must be ordered separately as needed. Maximum Stem Length: 8 Ft. 6-inches; consult factory for longer lengths. Stem thread: 1/4-18NPS.
- Flexible Cable Pendant Mount Cylinders include 120-inches of Field Adjustable 18/3 SJTOW Cable.

Performance Summary

- Optical system employs either a Clear or Platinum reflector. Clear reflector is available in Narrow (36°), Medium (54°) and Wide (80°) beam distributions. Platinum is only available in a single beam distribution (57°).
- Wall Wash and Pencil Beam optic accessories are also available on select models
- Select from 2700K, 3000K, 3500K and 4000K color temperatures; CRI 80 min., 83 typical; High CRI 90+ available
- Excellent fixture-to-fixture color consistency within a 3-step MacAdam Ellipse tolerance
- Wet Location models must be installed per specific product installation instructions and all appropriate National Electrical Codes
- All CYL6 Cylinders are available for non-dimming and dimming applications. For a list of compatible dimmers, refer to Dimming Specification sheet.
- Assembled in the U.S.A

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CATALOG NO.

DATE PROJECT TYPE

CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

PHOTOMETRICS

CYL6630KMVDCMCLR

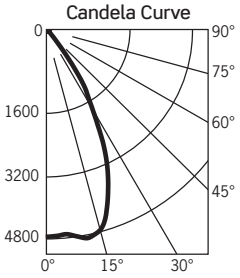
Fixture Delivered Lumens: 3603
Total Watts@120V: 43.0
Lumens Per Watt: 83.8
Center Beam Candle Power: 4747
Beam Distribution: 54°
Spacing Criterion: 0.82
Color Rendering Index (CRI)[1]: 83
Color Temperature (CCT)[2]: 2988K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. 85098
LM-79 Test No. 85099

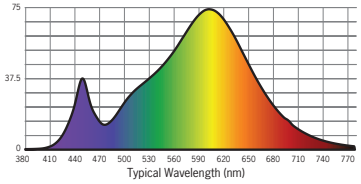
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	131.9	5.4
8'	74.2	7.2
10'	47.5	9.0
12'	33.0	10.8
14'	24.2	12.6
16'	18.5	14.4

Candela Curve



Spectral Power Distribution Chart[4]



CYL6630KMVDCNCLR

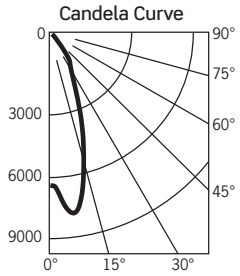
Fixture Delivered Lumens: 3567
Total Watts@120V: 43.0
Lumens Per Watt: 83.0
Center Beam Candle Power: 6579
Beam Distribution: 36°
Spacing Criterion: 0.63
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3027K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. 85317
LM-79 Test No. 85321

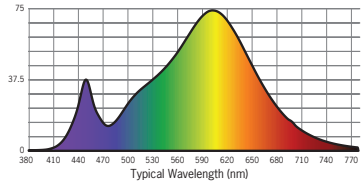
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	182.8	3.9
8'	102.8	5.3
10'	65.8	6.6
12'	45.7	7.9
14'	33.6	9.2
16'	25.7	10.5

Candela Curve



Spectral Power Distribution Chart[4]



CYL6630KMVDWCLR

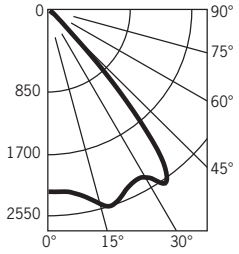
Fixture Delivered Lumens: 3749
Total Watts@120V: 44.4
Lumens Per Watt: 84.4
Center Beam Candle Power: 2248
Beam Distribution: 80°
Spacing Criterion: 1.19
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3025K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. 84842
LM-79 Test No. 85701

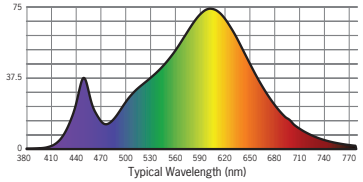
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	62.4	8.9
8'	35.1	11.9
10'	22.5	14.9
12'	15.6	17.9
14'	11.5	20.8
16'	8.8	23.8

Candela Curve



Spectral Power Distribution Chart[4]



1. Accuracy of rendering colors 2. Color appearance of light source 3. Dependent on surrounding temperatures 4. Colors present within the light source

PHOTOMETRIC MULTIPLICATION FACTORS

Lumen output values fluctuate based on CCT. To estimate lumen output of the various CCT/CRI options, multiply 3000K (80 CRI min) results by the following:

CCT	STD CRI	HIGH CRI	SERIES 1	SERIES 2	SERIES 3	SERIES 4	SERIES 5	WHT/PL REFLECT.
2700K	0.94	0.70	0.29	0.39	0.53	0.73	0.90	1.0
3000K	N/A	0.75	0.29	0.39	0.53	0.73	0.90	1.0
3500K	1.0	0.81	0.29	0.39	0.53	0.73	0.90	1.0
4000K	1.0	0.87	0.29	0.39	0.53	0.73	0.90	1.0

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CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

PHOTOMETRICS

CYL6630KMVDCPL

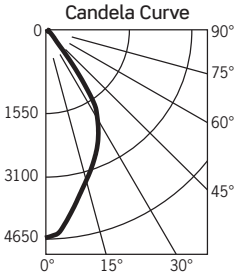
Fixture Delivered Lumens: 3423
Total Watts@120V: 43.0
Lumens Per Watt: 79.6
Center Beam Candle Power: 4582
Beam Distribution: 57°
Spacing Criterion: 0.80
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3033K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. 85318
LM-79 Test No. 85322

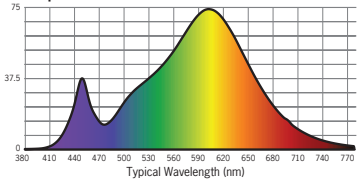
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	127.3	4.8
8'	71.6	6.4
10'	45.8	8.0
12'	31.8	9.6
14'	23.4	11.3
16'	17.9	12.9

Candela Curve



Spectral Power Distribution Chart[4]



CYL6630KMVDCXPB

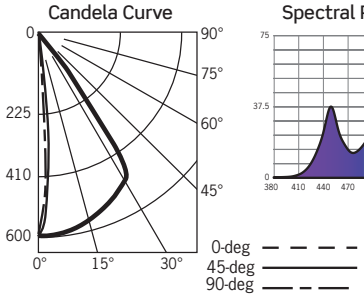
Fixture Delivered Lumens: 95
Total Watts@120V: 42.3
Lumens Per Watt: 2.2
Center Beam Candle Power: 614
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3033K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. G16122102
LM-79 Test No. 85322

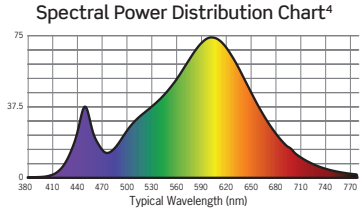
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	17.1	6.6 x 0.9
8'	9.6	8.8 x 1.2
10'	6.1	11.0 x 1.5
12'	4.3	13.2 x 1.7
14'	3.1	15.4 x 2.0
16'	2.4	17.6 x 2.4

Candela Curve



Spectral Power Distribution Chart[4]



CYL6630KMVDCWW

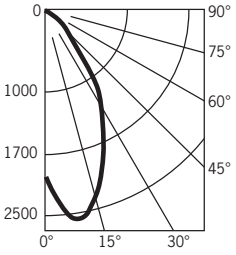
Fixture Delivered Lumens: 1827
Total Watts@120V: 42.4
Lumens Per Watt: 43.1
Center Beam Candle Power: 2024
Color Rendering Index (CRI)[1]: 82
Color Temperature (CCT)[2]: 3033K

Designed for 50,000 Hour Lamp Life[3]
LM-63 Test No. G16122101
LM-79 Test No. 85322

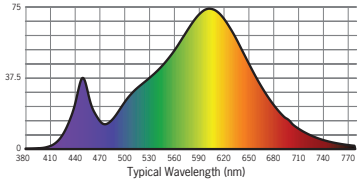
Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
6'	56.2	5.1 x 5.9
8'	31.6	6.8 x 7.9
10'	20.2	8.5 x 9.9
12'	14.1	10.2 x 11.9
14'	10.3	11.9 x 13.9
16'	7.9	13.7 x 15.9

Candela Curve



Spectral Power Distribution Chart[4]



1. Accuracy of rendering colors 2. Color appearance of light source 3. Dependent on surrounding temperatures 4. Colors present within the light source

PHOTOMETRIC MULTIPLICATION FACTORS

Lumen output values fluctuate based on CCT. To estimate lumen output of the various CCT/CRI options, multiply 3000K (80 CRI min) results by the following:

CCT	STD CRI	HIGH CRI	SERIES 1	SERIES 2	SERIES 3	SERIES 4	SERIES 5	WHT/PL REFLECT.
2700K	0.94	0.70	0.29	0.39	0.53	0.73	0.90	1.0
3000K	N/A	0.75	0.29	0.39	0.53	0.73	0.90	1.0
3500K	1.0	0.81	0.29	0.39	0.53	0.73	0.90	1.0
4000K	1.0	0.87	0.29	0.39	0.53	0.73	0.90	1.0

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CATALOG NO.

DATE PROJECT TYPE

CYL6 SERIES | 6" Indoor/Outdoor Integrated LED Specification Grade Round Cylinders

BUG RATINGS

Valid for all mountings except UD (Up/Down) or U (Up)

WATTAGE	REFLECTOR SELECTION					
	NARROW	MEDIUM	WIDE	PLATINUM	WALL WASH*	PENCIL BEAM
SERIES 1/10W	B1 U0 G0	B1 U0 G0	B1 U0 G1	B1 U0 G1	B0 U0 G0	B0 U0 G0
SERIES 2/14W	B1 U0 G0	B2 U0 G0	B2 U0 G0	B2 U0 G0	B0 U0 G0	B0 U0 G0
SERIES 3/20W	B1 U0 G0	B2 U0 G0	B2 U0 G0	B2 U0 G0	B0 U0 G0	B0 U0 G0
SERIES 4/28W	B1 U0 G0	B2 U0 G0	B2 U0 G0	B2 U0 G0	B0 U0 G0	B0 U0 G0
SERIES 5/37W	B2 U0 G0	B3 U0 G0	B3 U0 G1	B3 U0 G1	B1 U0 G0	B0 U0 G0
SERIES 6/43W	B2 U0 G0	B3 U0 G0	B3 U0 G1	B3 U0 G1	B1 U0 G0	B0 U0 G0

**WW rating based on reflector used as Forward Throw*

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DIMMING SPECIFICATIONS | 6" and 8" Cylinders: CYL6 Series, SQL6 Series and CYL8 Series

- Incandescent 120VAC dimmers adjust the light with "forward phase control," where the dimmer "chops" the forward part of the AC wave to deliver less or more power to the light source. No neutral wire connection required.
- Electronic vow voltage 120VAC dimmers adjust the light with "reverse phase control," where the dimmer "chops" the back part of the AC wave to deliver less or more power to the light source. Neutral wire connection required.
- 0-10V DC low voltage dimmers operate using two low voltage dimming wires that are separate from the 120V or 277V AC power. The dimmer sends a variable output voltage to the fixture based upon the dimming level. 10V corresponds to undimmed operation, 5V to 50% and so on. Switching on/off is controlled with the line voltage power (120V or 277V AC) input to the dimmer and then dimming operation is controlled with the 0-10V DC low voltage wiring connection between the dimmer and the LED driver. The control signal runs on two low voltage control wires (color coded violet and gray).
- Lutron HiLume and EcoSystem dirvers provide continuous dimming from 1%-100%. For a complete list of compatible dimmers and controls, please visit www.lutron.com
- Use DALI approved controls for dimming eldoLED MVD7 (1%-100%) and MVD9 (0.1%-100%) options.

			Driver Options 12D3, MVD	Driver Option MVD6	Driver Option MVD8
Manufacturer	Product	Model	Light Output	Light Output	Light Output
Leviton	IllumaTech	IPI06-1LZ	1%-100%	NA	NA
Leviton	SureSlide	6631-2	1%-100%	NA	NA
Leviton	Vizia	VPE06	9%-100%	NA	NA
Leviton	Trimatron	6683-IW	6%-100%	NA	NA
Leviton	Decora	6161	15%-100%	NA	NA
Leviton	SureSlide	6633-P	1%-100%	NA	NA
Leviton	IllumaTech	IPE04	6%-100%	NA	NA
Leviton	IllumaTech	IP710-DLX	NA	1%-100%	0.1%-100%
Cooper	Devine	DLC03P	1%-100%	NA	NA
Cooper	Skye	SLC03P	0%-100%	NA	NA
Cooper	Decorator	DAL06P	0%-100%	NA	NA
Pass & Seymour	Titan	CD4FB-W	NA	1%-100%	0.1%-100%
Synergy		ISD BC	NA	1%-100%	0.1%-100%
Watt Stopper	Miro Decorator	DCLV1	NA	1%-100%	0.1%-100%
Lutron	Ariadni	TGCL-153P	1%-100%	NA	NA
Lutron	Ariadni	TG-600P	13%-100%	NA	NA
Lutron	Diva	DVCL-153P	1%-100%	NA	NA
Lutron	Diva	DV600P	6%-100%	NA	NA
Lutron	Diva	DVELV303P	6%-100%	NA	NA
Lutron	Diva	DVTV	NA	1%-100%	0.1%-100%
Lutron	Faedra	FAELV500	12%-100%	NA	NA
Lutron	Lumea	LG600P	8%-100%	NA	NA
Lutron	Maestro	MAELV600	16%-100%	NA	NA
Lutron	Nova	NFTV	NA	1%-100%	0.1%-100%
Lutron	Nova T	NTFTV	NA	1%-100%	0.1%-100%
Lutron	Skylark	S-603PG	5%-96%	NA	NA
Lutron	Skylark	S600P	5%-100%	NA	NA
Lutron	Skylark	SELV300P	10%-100%	NA	NA
Lutron	Skylark	CT103P	9%-100%	NA	NA

NOTES

1. Testing was performed with a single fixture connected to dimmer.
2. Testing has been performed on these dimmers, but this does not imply any warranty of compatibility.
3. Dimming performance can be influenced by different loads, as well as variations in dimmer switches within the same model.
4. Dimmer maximum load rating with LED may differ from published traditional source dimmer ratings. Consult manufacturer for maximum dimmer information.
5. Consult factory for additional dimming information.

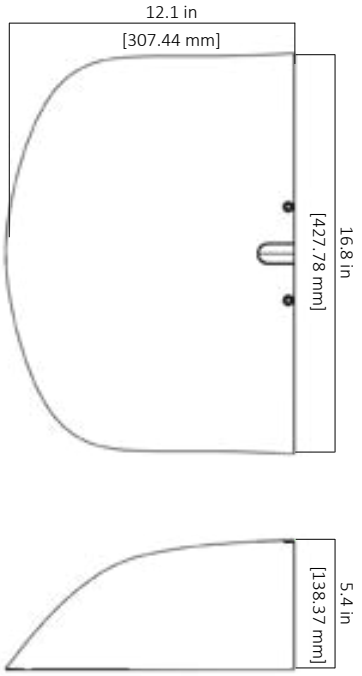
LEOTEK LITE-ON GROUP

Project
Type
Catalog No.

Eseta™ LED Wall Sconce
ES1

Luminaire Data

Weight 9.9 lbs [4.5 kg]
14.6 lbs [6.5kg] with EM, MS options



Ordering Information

Sample Catalog No. ES1 24H MV NW W BK 700 EM

Product	No. & Type of LEDs	Voltage	Color Temperature[1]	Distribution	Finish[2]	Drive Current[3]	Options
ES1	**24H** 24 LEDs **48H** 48 LEDs	**MV** 120-277V **HV** 347-480V	**WW** 3000K **NW** 4000K **CW** 5000K	**W** Wide **FT** Forward Throw	**BK** Black **DB** Dark Bronze **GY** Gray **WH** White	**350** 350mA **530** 530mA **700** 700mA	**PC**[6] Photo Control **MSL2** Motion Sensor, L2 Lens **MSL3**[4] Motion Sensor, L3 Lens **EM**[5] Emergency Battery System - Cold Weather Rated (-20ºC/ -4ºF) **FSIR100** Motion Sensor Configuration Tool

Notes
1 Consult factory for other color temperatures.
2 Consult factory for non-standard finish options. See page 2 for specifications.
3 Factory set drive current, non-field adjustable. 700mA is not available for 48H version. Refer to performance data on page 2. Consult factory for other drive current options.
4 Motion Sensor available with MV only. Motion Sensor default setting dims luminaire to 50% when no motion is detected for 5 minutes. Field adjustable settings available using FSIR100 option.
5 Emergency Battery System available with MV only. 3-year limited warranty on Emergency Battery System.
6 Available with MV. For HV specify either 347V or 480V.

LEOTEK LITE-ON GROUP

Eseta™ LED Wall Sconce
ES1

Luminaire Specifications

Housing
Die cast aluminum housing with back mounting plate and outdoor rated cable. Back mounting plate includes novel hanging features to allow one-person installation. Knockouts on the top and bottom of the housing allow conduit entry. Electrical components are accessed behind gasketed optical cover.

Light Emitting Diodes
Hi--flux/Hi-power white LEDs are tested in accordance with IES LM--80 testing procedures. Warm White (3000K), Neutral White (4000K) and Cool White (5000K) with minimum 70 CRI are standard. LEDs are 100% mercury and lead free.

Optical Systems
The OMNILens™ system creates a low brightness source to reduce glare with precise Wide or Forward Throw distributions. Lens cover is UV stabilized, vandal-resistant polycarbonate. Luminaire produces 0% total lumens above 90° (BUG Rating, U=0).

Electrical
Power supply features a minimum power factor of .90 and <20% Total Harmonic Distortion (THD). EMC meets or exceeds FCC CFR Part 15. Transient voltage complies with ANSI C62.41 Cat. A. Integral surge protector is tested per ANSI/ IEEE C62.45 procedures based on ANSI/IEEE C62.41.2 definitions for standard and optional waveforms for Location Category C High.

Finish
Housing receives a fade and abrasion resistant epoxy polyester powder coat. Finish tested to withstand 5000 hours in salt spray exposure per ASTM B117. Finish tested 5000 hours in UV exposure per ASTM G154 and meets ASTM D523 gloss retention.

Listings/Ratings/Labels
Luminaires are UL listed for use in wet locations and emergency lighting in the United States and Canada. Ambient operating temperature is -40°C to 40°C with non- EM unit. Entire fixture maintains an IP66 and IK10 rating. DesignLights Consortium™ 3000K, 4000K and 5000K qualified product. Assembled in the United States.

Photometry
Luminaires are photometrically tested by certified independent testing laboratories in accordance with IES LM-79 testing procedures.

Lumen Maintenance

	TM-21 Lumen Maintenance (hours) at 25°C	
Models	**At 50,000**	**At 100,000**
ES1-24H	99%	97%
ES1-48H	97%	93%

Warranty
10-year limited warranty is standard on luminaire and components. 5-year limited warranty on motion sensor and photo control. 3-year limited warranty on Emergency Battery System.

Color Specifications

Order Code	Color	RAL #	Pantone Equivalent
GY	Gray	7040	429C
BK	Black	9004	426C
DB	Dark Bronze	6022	BLACK 2C
DB1	Dark Bronze	8019	412
WH	White	9003	11-0601
NA	Natural Aluminum	9006	N/A

ES-1_Specification_Sheet_2-4-21. Specifications subject to change without notice.

LEOTEK LITE-ON GROUP

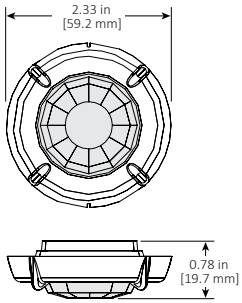
Eseta™ LED Wall Sconce
ES1

Performance Data
All data nominal, consult factory for IES files or LM-79 reports.

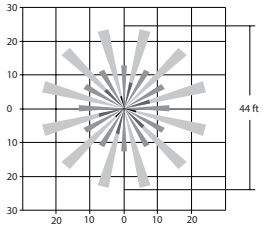
CCT	Two Distributions		Wide Distribution			Forward Throw Distribution		
	No. of LEDs & Type	Drive Current (mA)	System Wattage (W)	Delivered Lumens (Lm)	Efficacy (Lm/W)	System Wattage (W)	Delivered Lumens (Lm)	Efficacy (Lm/W)
3000K	24H	350	29	3621	125	29	3618	125
		530	45	5265	117	43	5203	119
		700	57	6421	113	57	6516	114
	48H	530	83	8826	106	81	8751	108
4000K	24H	350	29	3944	136	30	4050	136
		530	45	5580	124	43	5418	126
		700	58	6957	120	58	7023	121
	48H	530	82	8707	106	83	8466	102
5000K	24H	350	29	3730	130	30	3922	132
		530	44	5131	118	43	5139	119
		700	58	6521	112	56	6260	112
	48H	530	82	9839	120	84	9585	115

Eseta™ LED Wall Sconce
ES

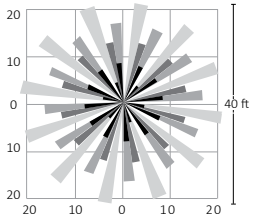
Motion Sensor (Optional) Data



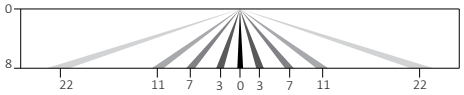
L2 Lens Coverage Top View



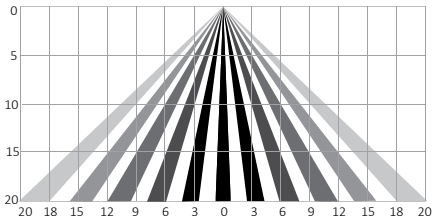
L3 Lens Coverage Top View



L2 Lens Coverage Side View



L3 Lens Coverage Side View



Motion Sensor (Optional) Specifications

Description
Digital passive infrared luminaire integrated outdoor occupancy sensor provides high/low/off control based on motion. Initial setup and subsequent sensor adjustments are made using a handheld configuration tool.

Operation
Standard factory setting will dim the luminaire to 50% until motion is sensed and then it will power to 100%. When motion is not detected for five minutes, the luminaire will dim back to 50%. Ramp up and fade down times are adjustable, but initially set to NONE.

The percent dimming and time durations may be field adjusted as required using FSIR100 option. FSIR user guide available at: www.wattstopper.com.

Optical System
Multi-cell, multi-tier Fresnel lens with a 360 degree view detects unobstructed motion. L2 lens is designed for a mounting height up to 8 feet and detects motion up to 3 times mounting height. L3 lens is designed for a mounting height up to 20 feet and detects motion within one mounting height.

Finish
Sensor exterior ring and lens are white polycarbonate, UV and impact resistant.

Listings/Ratings
Sensor is TUV, UL and cUL listed, IP66 rated and CE compliant.

Warranty
5-year limited warranty on luminaires and components with a motion sensor.

Emergency Battery System (Optional) Specifications

Description
Emergency battery system option provides a nominal 2300 lumens for a minimum of 90 minutes and can be specified with motion sensor option. Test switch and charging indicator light are visible and accessible on the optical cover.

Temperature Rating
Ambient operating temperature is -20C to +60C.

Listings/Ratings/Labels
Emergency LED driver and batteries are UL recognized and CSA certified. Emergency illumination time exceeds the National Electrical Code (NEC), Life Safety Code (NFPA-LSC), National Building Code of Canada (NBC), National Fire Code of Canada (NFC) and UL 90-minute requirements.

Warranty
3-year limited warranty on Emergency Battery System.

ES-1_Specification_Sheet_2-4-21. Specifications subject to change without notice.

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Surface Mount

Signal White is standard finish

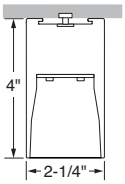
Note: see page 6 for all aesthetic options

High Performance 2" Aperture is a patented, linear LED luminaire family. HP-2 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

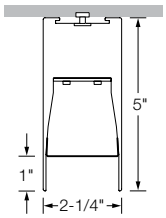
CROSS SECTIONS

Surface Mount



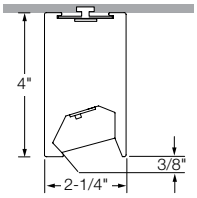
Flush Downlight Diffuser (standard)

Surface Mount Regressed



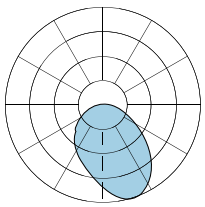
Flat Diffuser with 1" Regressed (RG)

Wall Wash Surface Mount

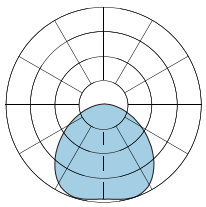


Kicker (standard)

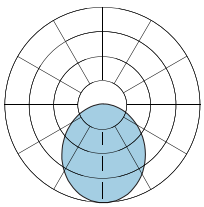
OPTIC OPTIONS



Downlight Asymmetric Optic (**DAO**)



Downlight Spread Optic (**DSO**)

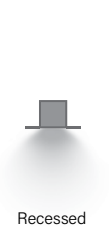


Standard Downlight Flush Optic (**F**)

ALSO AVAILABLE IN

Pendant (**D, ID, I**)

Wall Mount (**WM**)



Recessed (**R**)

Also available in Indigo-Clean. See Indigo-Clean Tech Sheet

A brand of legrand®

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Surface Mount

Clear Form

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	◉ 2	◯ SM - Surface Mount ◯ SM RG - Direct Regressed (Wall Wash not available)	◯ D - Direct ◯ WW-D - Wall Wash Direct	_____ Minimum 2'section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT AND LED TYPE

Downlight Output (Flush)

- ◯ S - Standard (329 lm/ft)
- ◯ B - Boosted (414 lm/ft)
- ◯ H - High (625 lm/ft)
- ◯ V - Very High (804 lm/ft)
- ◯ TL - Tailored:_____ lm/ft*

Lumen provide are for Flush lens only, see pg. 9 for WW lumens
* Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

OUTPUT AND LED TYPE

LED CRI/CCT

- ◯ 830 - 80 CRI, 3000K
- ◯ 835 - 80 CRI, 3500K
- ◯ 840 - 80 CRI, 4000K
- ◯ 930 - 90 CRI, 3000K
- ◯ 935 - 90 CRI, 3500K
- ◯ 940 - 90 CRI, 4000K
- ◯ 8TW - 80 CRI, Tunable White
- ◯ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Downlight

- ◯ F - Flush (standard) [1]
- ◯ BG - Bottom Glow [1]
- ◯ DL - 1" Drop Down Lens [1]
- ◯ RG-D - Flat Diffuser with 1" Regress [2]
- ◯ RG-WCB - White Cross Blade Baffle [2]
- ◯ RG-LHE - Hollowed Ellipse Louver [2]
- ◯ RG-LHC - Hex Louver [2]
- ◯ DAO-L - Downlight Asymmetric Optic Left [1, 5]
- ◯ DAO-R - Downlight Asymmetric Optic Right [1, 5]
- ◯ DSO - Downlight Spread Optic [1, 5]
- ◯ K - Kicker for Wall Wash only (standard) [6]
- ◯ FO - Fully Open for Wall Wash only

Reflector System

- ◯ 96LG - 96 Low Gloss White
- ◯ SW - Signal White for Wall Wash only

ELECTRICAL OPTIONS

Voltage

- ◯ 120 - 120 Voltage
- ◯ 277 - 277 Voltage
- ◯ 347 - 347 Voltage

Circuiting [3]

- ◯ SC - Single Circuit* One single circuit in a run
- ◯ MC - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required

* Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS

Driver Selection

0-10V Driver Options

- ◯ FC-10% - 0-10V 10% [4] (standard)
- ◯ FC-1% - 0-10V 1% [4]
- ◯ OSR-10% - Osram OTi, 0-10V 10% [4]
- ◯ OSR-1% - Osram OTi, 0-10V 1% [4]
- ◯ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%
- ◯ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [4]

DALI Driver Options

- ◯ FC-DALI-1% - DALI 1%
- ◯ OSR-DALI-1% - Osram Dexal, 1%
- ◯ ELD-DALI-0% - EldoLED SOLOdrive, 0.1%
- ◯ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*

DMX Driver Options

- ◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [7]
- ◯ ELD-DMX - EldoLED POWERdrive, 0.1%
- ◯ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options

- ◯ LUT-ES1 - Lutron, Ecosystem 1%
- ◯ LUT-2W - Lutron, 2-wire (120V only) 1%
- ◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Ceiling Hardware Type

- ◯ C1 - 1" T-Bar
- ◯ C2 - 9/16" T-Bar
- ◯ C3 - Screw Slot
- ◯ C4 - Hard Ceiling

OTHER OPTIONS

Endcap Style

- ◯ FE - Flat Endcap (standard)
- ◯ DE - 1" Drop Endcap [8]
- ◯ OE - Open Endcap [9]

Finish

- ◯ SW - Signal White (standard)
- ◯ FB - Finelite Black
- ◯ SA - Satin Aluminum
- ◯ #### - RAL Color Code [10]

_____

Emergency Style (Optional) Clear Selection

- ◯ LGD18W - Legrand 18W Brand Battery Back-up
- ◯ LGD10W - Legrand 10W Brand Battery Back-up
- ◯ EM/GN - Emergency to Generator
- ◯ NL - Night Light
- ◯ BSL310LP - Bodine Battery Back up Low Profile
- ◯ GTD - Generator Transfer Device
- ◯ ALCR - Automatic Load Control Relay

Integrated Sensor (Optional) Clear Selection

- ◯ OBO - Occupancy [11]
- ◯ OBD - Daylight [11]
- ◯ W601 - Wattstopper [12] Wireless Sensor
- ◯ OBE - Enlighted [13]
- ◯ REE - Remote Enlighted [14]

Special Options (Optional) Clear Selection

- ◯ CP - Chicago Plenum [15]
- ◯ RLA - Red List Approved
- ◯ RLD - Declared

[1] Not available with Wall Wash
[2] Regressed only
[3] Contact factory for switching options
[4] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[5] Not available with Regressed or Curves
[6] Kicker standard in Signal White. Customer Custom color kickers have a surcharge
[7] B & V outputs only
[8] 1" Drop Down Lens downlight only
[9] Available with Hollowed Ellipse Louver (**LHE**) only
[10] 20 business days lead time for color
[11] Not available with Wall Wash
[12] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.
[13] Enlighted components installed by Finelite, provided by others
[14] Enlighted for Wall Wash fixtures. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor.
[15] Only available with C1, C2, and C3 mounting hardware with Finelite Gridbox

Protected by one or more US Patents: 8915613; D702,391; D702,390; D700,732

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Surface Mount

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Surface Mount

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS[1]: Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, Regressed Diffuser, or White Cross Blade Baffle[2]. Corners not available with Wall Wash (**WW-D**), Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**) or 1" Drop Down Lens. Contact factory for double miters using the White Cross Blade Baffle. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), Bottom Glow (**BG**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**)[3], Ellipse Louver (**LHE**)[3], Hex Louver (**LHC**)[3], Downlight Asymmetric Optic (**DAO**)[4], Downlight Spread Optic (**DSO**)[4], and Regressed downlight diffusers (**RG**). 1" Drop Down Lens made of highly efficient acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Spread & Downlight Asymmetric Optics are extruded lenses with a subtle ribbed appearance providing a batwing or asymmetric distribution for improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint. The standard Semi-Specular Aluminum (**SSA**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed controlling uplight and downlight together (power and dimming). Specify dual feeds for independent control of uplight and downlight. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.

- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:

- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series)).
- **LUT-2W (LTEA2W)** - (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.

- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime.:** 100,000 hours
- FineTune DMX is 1%

LUTRON TUNABLE WHITE DRIVER OPTION: LUT-TW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE: Lay-in ceiling types: caddy clip with 1/4" - 20 stud and nut. Drywall or concrete surfaces (walls or ceilings): 1/4" - 20 stud and nut (provided by others). Mounted with three equidistant suspension points.

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX

[1] Not available with Wall Wash
[2] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[3] Regressed only
[4] Not available with Regressed or Curves

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Surface Mount

SPECIFICATIONS

feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER FEATURES

ENDCAPS: Flat diecast aluminum endcaps (**FE**) add 1/4" to each end of luminaire. 1" Drop Down Lens Endcap (**DE**) includes diffuse element to continue luminance of drop lens. Open Endcap (**OE**) is for use with the Hollowed Ellipse Louver (**LHE**)[5]; following the curve of the louver.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery

	Legrand 18W	Legrand 10W/ Bodine BSL310LP
HP2-P-D		
Min. Housing Length	8'*	4'**
EM Lumen Output	1608	956
EM Section Illuminated	2'	2' or 4'
HP2-P-WW-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	1500	891
EM Section Illuminated	4'	4'

* Minimum fixture housing length for battery pack approved without sensor
** Exception: 5' not available, 6'+ okay

Bodine GTD and Legrand ALCR Min. Length

Configuration	Min Length
Generator	6'
Generator + OCC	8'
Daylight	6'
Generator + Daylight	8'

Tunable White ELECTRICAL OPTIONS[6]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**), and Satin Aluminum (**SA**) are standard. Optional Adder: 185 RAL colors[7] are available.

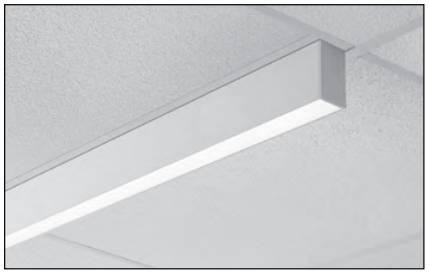
LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These fixtures are rated for Damp Location. HP-2 can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

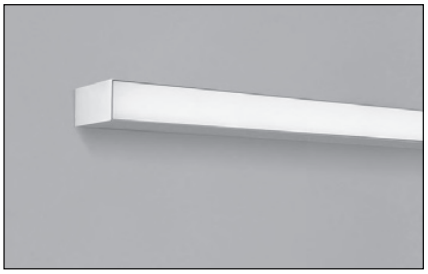
WEIGHT[8]: SM - 2.3 lb/ft; WW - 2.9 lb/ft

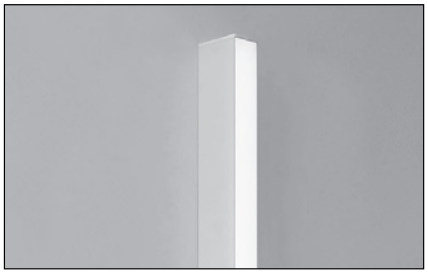
WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

[5] Regressed only
[6] Consult Finelite for Generator Transfer Device and Battery Back up fit
[7] 20 business days lead time for color
[8] Excludes Battery Back up and Generator Transfer Device weight

SURFACE MOUNT OPTIONS


Ceiling Surface Mount


Horizontal Surface Mount

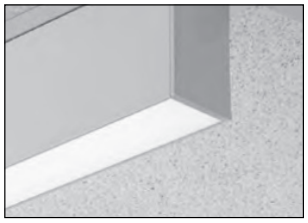

Vertical Surface Mount

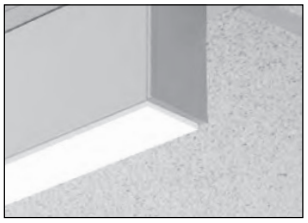
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

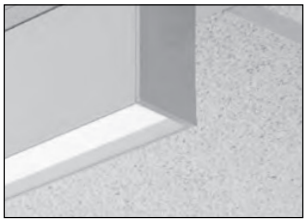
High Performance 2" Aperture (HP-2) Surface Mount

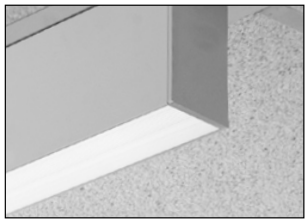
AESTHETIC OPTIONS

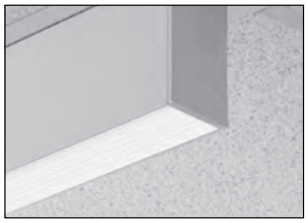

Flush Diffuser (**F**)

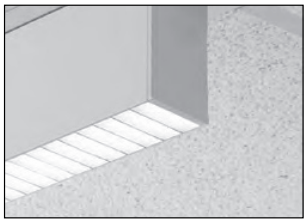

Bottom Glow Diffuser (**BG**)


1" Drop Down Lens (**DL**)

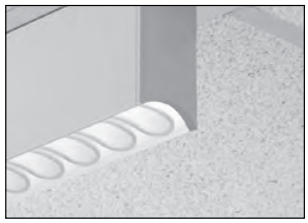

Flat Diffuser with 1" Regressed (**RG-D**)

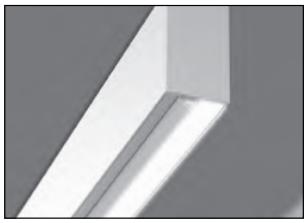

Downlight Asymmetric Optic (**DAO**) [1]
Externally flush


Downlight Spread Optic (**DSO**) [1]
Externally flush


White Cross Blade Baffle [2] (**RG-WCB**)


Hex Louver [2] (**RG-LHC**)


Hollowed Ellipse Louver [2] (**RG-LHE**)

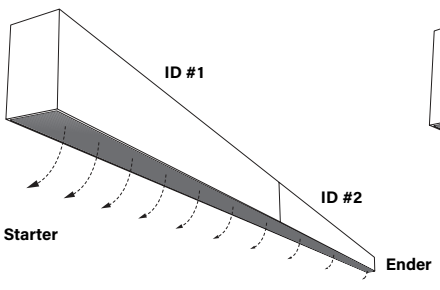

Kicker (**K**) - Wall Wash only

[1] With a subtle ribbed appearance providing specialized distribution
[2] Regressed only. Not available with Wall Wash

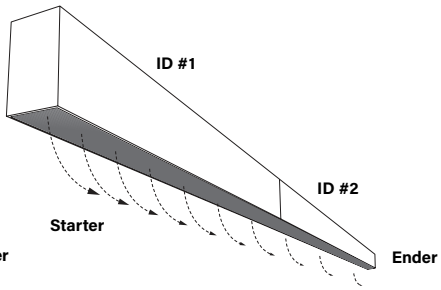
DOWNLIGHT ASYMMETRIC OPTIONS

Use this tool to understand how to specify Downlight Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify DAO-L distributes light to the left or DAO-R distributes light to the right.

Downlight Asymmetric Optic Left (DAO-L)



Downlight Asymmetric Optic Right (DAO-R)



PREINSTALLED LABEL

For DAO, Preinstalled label on diffuser shows direction of light. Remove after installation.

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

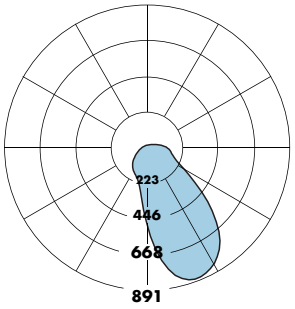
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Surface Mount

Wall Wash Recessed - 4' Luminaire 3500K

HP2-R-WW-D-K-4'-V-835
Downlight: With Kicker

Efficacy: 76 lm/W
Total luminaire output: 1500 lumens (375 lm/ft)
19.6 watts (4.9 W/ft)
Peak Candela Value: 882 @ 25º
CRI: 80 / CCT: 3500K
ITL LM79 Report 85137



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B [1]**	**H [1]**	**V [2]**
614	772	1167	1500

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
154	193	292	375

Power, 3500K (Watts Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
2.0	2.5	3.8	4.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B [1]**	**H [1]**	**V [2]**
76	77	77	77

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85137

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 1167 lm x 0.789 = 921 lm
Total Light Output per Foot: 292 lm/ft x 0.789 = 230 lm/ft.
watts/foot: 3.8 W/ft.

$$\textbf{Efficacy} = \frac{292\ \frac{\text{lm}}{\text{ft.}}}{3.8\ \frac{\text{W}}{\text{ft.}}} = 61\ \text{lm/W}$$

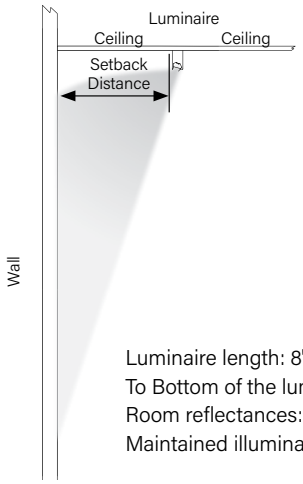
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Surface Mount

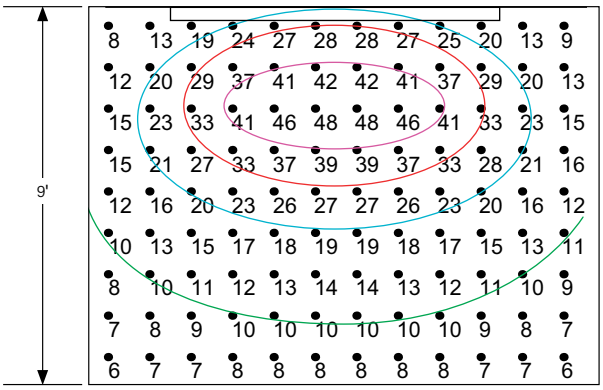
WALL WASH RECESSED - SETBACK INFO AND APPLICATION DATA

HP2-SM-WW-D-K-4'-V-835
Downlight: With Kicker
Total luminaire output: 1500 lumens (375 lm/ft)
19.6 watts (4.9 W/ft)
CRI: 80 / CCT: 3500K



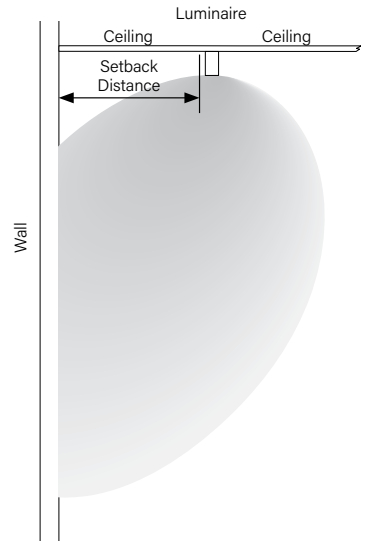
Luminaire length: 8'
To Bottom of the luminaire: 9'-0"
Room reflectances: 80-50-20
Maintained illuminance levels: LLF 0.86"

Setback Distance - 2'

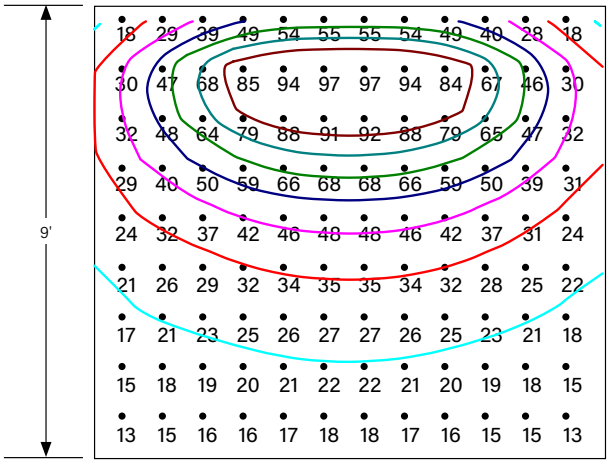


DOWNLIGHT ASYMMETRIC OPTIC - SETBACK INFO AND APPLICATION DATA

HP2-SM-D-4ft-V-835-DAO
Downlight: DAO
Total luminaire output: 3742 lumens (936 lm/ft)
35.6 watts (8.9 W/ft)
CRI: 80 / CCT: 3500K

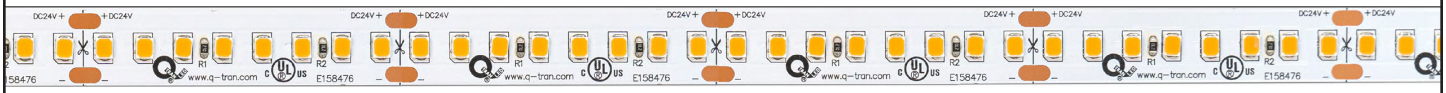


Setback Distance - 2'



SW-HE24/1.5

STRIP: High Efficacy Static White



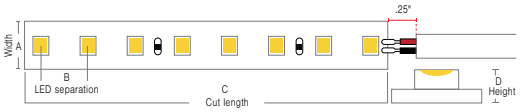
Our first high-efficacy, one step, one bin static white LED tape provides consistent color project to project with exceptional photometric qualities. SW-HE24/1.5, is a 1.5-watt/foot, 24-volt strip featuring 8 diodes per 2" cutpoint, is dry- and wet-rated, field-cuttable up to 768", and available in color temperatures ranging from 2000K to 4000K. Pair with an aluminum extrusion to create a custom fixture.

Technical Information [Calculated L70 = 70000 hours]

Tested with SW-HE24/1.5-DRY

CCT	Lumen/ft	Luminous Efficacy	CRI Ra	CRI R9	TM30 Rf	TM30 Rg
2000K	187	130 Lm/W	94	63	91	102
2200K	188	131 Lm/W	96	92	95	100
2400K	196	136 Lm/W	96	96	93	99
2700K	210	146 Lm/W	97	97	94	100
3000K	222	154 Lm/W	98	97	93	100
3500K	232	161 Lm/W	97	96	91	98
4000K	231	160 Lm/W	97	99	91	99

Dimensions



Section (in)	A	B	C	D
DRY (IP20)	0.47"	0.24"	2.00"	0.07"
DMP (IP54)	0.47"	0.24"	2.00"	0.15"
WET (IP67)	0.55"	0.24"	2.00"	0.16"

Part Number Builder

V/Watts	Rated	CCT - Lumens/CRI	Connector/ Wire In	Connector/ Wire Out	Wire Color	Wire Type	Illuminated Length (in)	
SW-HE24/1.5 Voltage: 24 VDC Wattage: 1.5 W/ft							2" increments	Matches EXT length ordered
	DRY (IP20)	20 - 2000K 187/94 22 - 2200K 188/96 24 - 2400K 196/96 27 - 2700K 210/97 30 - 3000K 222/98 35 - 3500K 232/97 40 - 4000K 231/97	BW BRL CLS CON6 CON24	CLS BW BRL CON6 CON24	WH BK N/A	CL2 CL2P N/A	2"-768" OR	MATCH
	DMP (IP54)	24 - 2400K ***/** 27 - 2700K ***/** 30 - 3000K ***/** 35 - 3500K ***/** 40 - 4000K ***/**	BW BRL CON6 CON24	CLS BW BRL CON6 CON24	WH BK N/A	CL2 CL2P N/A	2"-180" OR	MATCH
	ENC (IP67)							MATCH
	WET (IP67)	20 - 2000K 170/93 22 - 2200K 172/96 24 - 2400K 182/96 27 - 2700K 188/97 30 - 3000K 199/98 35 - 3500K 212/98 40 - 4000K 208/97	BW BRL	CLS BW BRL	WH BK N/A	CL2 CL2P N/A	2"-360" OR	MATCH

- If selecting **BRL**, select **N/A** for wire color and type
- **BW** comes in standard 24"- request custom length (Max 120") by writing it in inches next to "BW" in the order code box (ex. BW48)
- Wire orientation for **MATCH** will be dictated by extrusion Feed In/Feed Out selection
- **Connector/Wire In or Out not** needed to specify product. Standard configuration is BW for Wire In and CLS for Wire out
- If ordering an encapsulated extrusion, **ENC** (Encapsulated in Extrusion) must be chosen for your strip.
- ENC RATED STRIP ARE NOT FIELD CUTTABLE
- **CL2** wire is standard non-plenum wire, **CL2P** wire is plenum rated
- **ALL HE STRIPS MUST BE USED WITH A COMPATIBLE EXTRUSION**

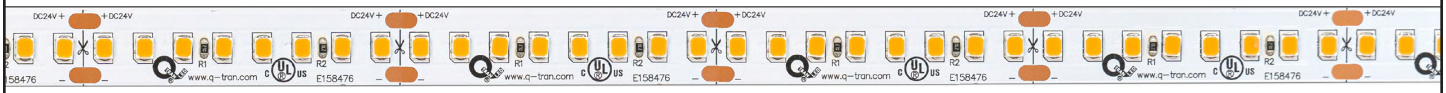
- 5 year warranty
- Field modifications must comply with Q-Tran's installation methods otherwise warranty is null & void
- All data has +/- 5% tolerance
- UL Listed
- Suitable for installation in the storage area of a clothes closet when assembled as a fixture at Q-Tran facility (Not applicable for encapsulation)
- Title 24 - JA8-2019 Strips: DRY and WET rated, 2000K and above
- Ambient or mounting surface must not be lower than -40°F or higher than 152°F

c UL us LISTED · 1-BIN 1-STEP · JA8-2016 · NEC 410.2 and 410.16 · RoHS COMPLIANT · 5 YEAR WARRANTY

Specification subject to change. Rev-03-23-22

SW-HE24/1.5

STRIP: High Efficacy Static White



Compatible Extrusions

	SLIM	WIDE	ROND	TORQ	TRE3	LALO	TALO
DRY		✓		✓	✓	✓	✓
DMP		✓		✓	✓	✓	✓
ENC				✓		✓	✓
WET		✓					

	ARKA	TELA	VEVE	FLUR	EMBD	LATO	MDIN	OPTI
DRY	✓	✓	✓	✓	✓	✓	✓	✓
DMP	✓	✓	✓	✓	✓	✓	✓	
ENC				✓	✓	✓		
WET								

Connector/Wire – In/Out

BW	BRL	CON6	CON24	CLS
.10"	.42" .35"	.38" .39"	.38" .39"	
Bare Wire 24"	Barrel 6"	Connector 6"	Connector 24"	Not soldered

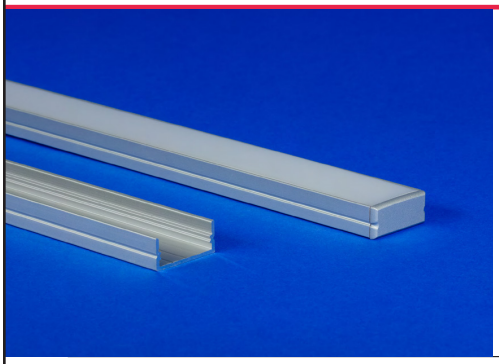
Compatible Power Supplies

See website for additional power supply options

QZ	iQ-PH-80
	

Specification subject to change. Rev-03-23-22

WIDE ALUMINUM EXTRUSION

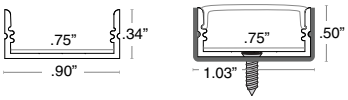


The WIDE LED extrusion is Q-Tran's widest profile extrusion, making it able to fit even our widest LEDs: RGBW. It is available in satin, black, and bronze finishes and is offered in three different lenses; clear, polar, and diffused. It has a unique plastic mounting clip, and with a clear lens, its light transmission is 97 degrees. WIDE can be configured with in-fed wires, back-fed wires, and wires from the left and right for both lead and exit, giving you more freedom with your design. Available in lengths up to 98.43".

Finish

SATIN | BLACK | BRONZE

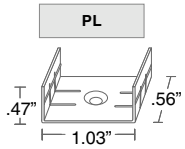
Dimensions



Profile | Profile with plastic mounting clip

Mounting

2 clips provided for 4' or less; 4 clips provided for greater than 4'



Plastic clip

Black clip standard with black extrusion

Part Number Builder

Product	Finish	Mounting	Lens	Type	Finished Fixture Length (in)
WIDE	ST BK BZ	PL	CL FR PR DF	S1 S2 S3 S4 — Single (Input Only) P1 P2 P3 P4 — Pass through (Input/Output) NI — Not installed (Strip not installed in factory)	1" increments from 1" - 98.43" Tolerance +0.0"/-0.5"

- Field modifications must comply with Q-Tran's installation methods otherwise warranty is null & void
- UL Listed when assembled with STRIP LEDs at Q-Tran
- Surface mount
- Suitable for installation in the storage area of a clothes closet when assembled as a fixture at Q-Tran facility (Not applicable for encapsulation or LED strips exceeding 4W/ft)
- Metallic end caps with white interior

c UL us LISTED | NEC 410.2 and 410.16 | RoHS COMPLIANT

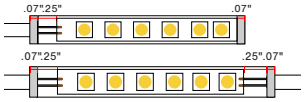
Specification subject to change. Rev-01-17-22

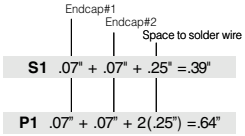
WIDE ALUMINUM EXTRUSION

Compatible Strips

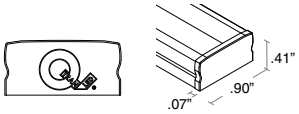
	STATIC WHITE (SW)	STATIC WHITE INDIVIDUALLY ADDRESSABLE (SW-IA)	STATIC WHITE STOCKING DISTRIBUTOR (SD-SW)	STATIC WHITE HIGH EFFICACY (SW-HE)	STATIC WHITE HIGH EFFICACY PLUS (SW-HE+)	DYNAMIC WHITE (DW)	DYNAMIC WHITE HIGH EFFICACY (DW-HE)	STATIC COLOR (SC)	WARM DIM (WD)	RGB	RGBW	RGBW HIGH EFFICACY (RGBW-HE)
	1.5W/ft 3.0W/ft 4.0W/ft 5.0W/ft 6.0W/ft	5.0W/ft	2.0W/ft 4.0W/ft 6.0W/ft	1.5W/ft 3.0W/ft 6.0W/ft 9.0W/ft	3.0W/ft 6.0W/ft	6.0W/ft	3.0W/ft 5.0W/ft 8.0W/ft	5.0W/ft	6.0W/ft	6.0W/ft	6.0W/ft	4.0W/ft 8.0W/ft
DRY	✓	✓	✓	✓ Not compatible with 9.0	✓	✓	✓	✓	✓	✓	✓	✓ Not compatible with 8.0
DMP	✓ Not compatible with 6.0			✓ Not compatible with 9.0		✓	✓ Not compatible with 8.0	✓		✓	✓	✓ Not compatible with 8.0
ENC												
WET	✓ Not compatible with 6.0		✓ Not compatible with 6.0	✓ Not compatible with 9.0	✓	✓	✓ Not compatible with 8.0	✓	✓	✓	✓	✓ Not compatible with 8.0

Length (in) Add to nominal LED length for fixture length

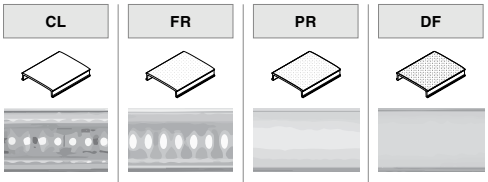




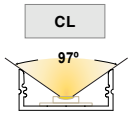
End Caps



Lens with LED visibility

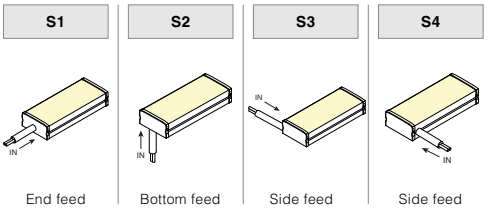


Cut Off

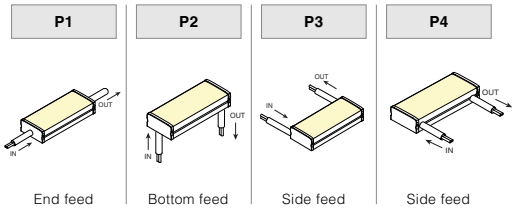


Type

SINGLE (Input only)



PASS THROUGH (Input/Output)

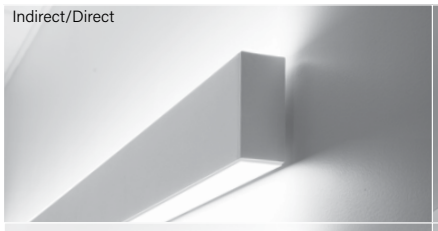


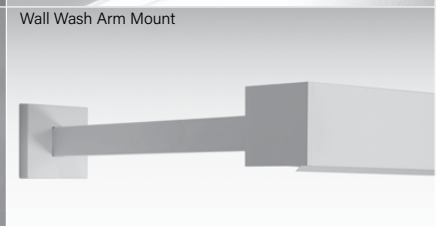
Specification subject to change. Rev-01-17-22

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount





High Performance 2" Aperture is a patented, linear LED luminaire family. HP-2 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

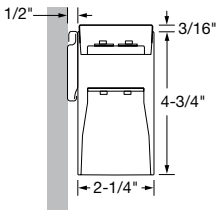
This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

Signal White is standard finish

Note: see page 6 for all aesthetic options

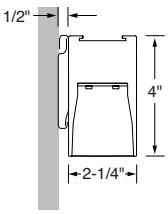
CROSS SECTIONS

Indirect/Direct
Top Glow Diffuser (standard)



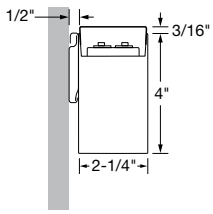
Flush Downlight Diffuser (standard)

Direct

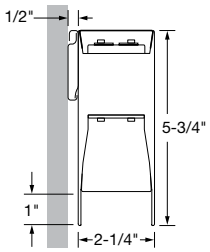


Flush Downlight Diffuser (standard)

Indirect
Top Glow Diffuser (standard)

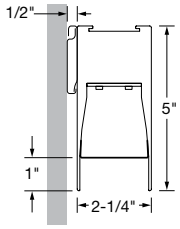


Indirect/Direct Regressed
Top Glow Diffuser (standard)



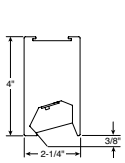
Flat Diffuser with 1" Regress (standard)

Direct Regressed

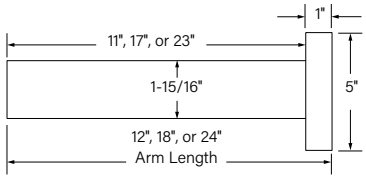


Flush Downlight Diffuser (standard)

Wall Wash Arm Mount



Kicker (standard)



ALSO AVAILABLE IN

Pendant (**D, ID, I**)

Recessed (**R**)

Surface Mount (**SM**)

Also available in Indigo-Clean. See Indigo-Clean Tech Sheet

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

Clear Form

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ **HP** - High Performance	◉ **2**	◯ **WM** - Wall Mount [1] ◯ **WM RG** - Wall Mount Regressed [1] ◯ **AM** - Arm Mount	◯ **D** - Direct ◯ **WW-D** - Wall Wash Direct ◯ **ID** - Indirect/Direct ◯ **I** - Indirect	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT AND LED TYPE

Uplight Output ID & I Only (Flush)
◯ **S** - Standard (393 lm/ft) ◯ **B** - Boosted (494 lm/ft) ◯ **H** - High (747 lm/ft) ◯ **V** - Very High (961 lm/ft) ◯ **TL** - Tailored:_____lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

OUTPUT AND LED TYPE

Downlight Output ID & D Only (Flush)	LED CRI/CCT
◯ **S** - Standard (322 lm/ft) ◯ **B** - Boosted (405 lm/ft) ◯ **H** - High (612 lm/ft) ◯ **V** - Very High (786 lm/ft) ◯ **TL** - Tailored:_____lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of these range.	◯ **830** - 80 CRI, 3000K ◯ **835** - 80 CRI, 3500K ◯ **840** - 80 CRI, 4000K ◯ **930** - 90 CRI, 3000K ◯ **935** - 90 CRI, 3500K ◯ **940** - 90 CRI, 4000K ◯ **8TW** - 80 CRI, Tunable White ◯ **9TW** - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Uplight	Downlight	Reflector System
◯ **TG** - Top Glow (standard) ◯ **F** - Flush ◯ **ASY-L** - Asymmetric Left Optic ◯ **ASY-R** - Asymmetric Right Optic ◯ **ASYTG-L** - Asymmetric Left Optic with Top Glow ◯ **ASYTG-R** - Asymmetric Right Optic with Top Glow	◯ **F** - Flush (standard) [1] ◯ **BG** - Bottom Glow [1] ◯ **DL** - 1" Drop Down Lens [2] ◯ **RG-D** - Flat Diffuser with 1" Regress [1, 2] ◯ **RG-WCB** - White Cross Blade Baffle [1, 2] ◯ **RG-LHE** - Hollowed Ellipse Louver [1, 2] ◯ **RG-LHC** - Hex Louver [1, 2] ◯ **DAO-L** - Downlight Asymmetric Optic Left [3] ◯ **DAO-R** - Downlight Asymmetric Optic Right [3] ◯ **K** - Kicker for Wall Wash only (standard) ◯ **FO** - Fully Open for Wall Wash only	◯ **96LG** - 96 Low Gloss White ◯ **SW** - Signal White for Wall Wash only

ELECTRICAL OPTIONS

Voltage	Circuiting [4]	Driver Selection
◯ **120** - 120 Voltage ◯ **277** - 277 Voltage ◯ **347** - 347 Voltage	◯ **SC** - Single Circuit* One single circuit in a run ◯ **DC** - Dual Circuit* [5] Independent control of up and down separately in an I/D style fixture ◯ **MC** - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required * Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)	**0-10V Driver Options** ◯ **FC-10%** - 0-10V 10% [6] (standard) ◯ **FC-1%** - 0-10V 1% [6] ◯ **OSR-10%** - Osram OTi, 0-10V 10% [6] ◯ **OSR-1%** - Osram OTi, 0-10V 1% [6] ◯ **ELD-10V-0%** - EldoLED SOLOdrive, 0-10V 0.1% ◯ **OSR-10V-TW** - Osram OTi, 0-10V 10% *(Tunable White)* [6] **DALI Driver Options** ◯ **FC-DALI-1%** - DALI 1% ◯ **OSR-DALI-1%** - Osram Dexal, 1% ◯ **ELD-DALI-0%** - EldoLED SOLOdrive, 0.1% ◯ **ELD-DALI-TW** - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)* **DMX Driver Options** ◯ **FIN-DMX** - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [7] ◯ **ELD-DMX** - EldoLED POWERdrive, 0.1% ◯ **ELD-DMX-TW** - EldoLED POWERdrive, 0.1% *(Tunable White)* **Lutron Driver Options** ◯ **LUT-ES1** - Lutron, Ecosystem 1% ◯ **LUT-2W** - Lutron, 2-wire (120V only) 1% ◯ **LUT-TW** - Lutron T-Series, EcoSystem 0.1% *(Tunable White)* See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method	Endcap Style	Finish
◯ **MB** - Mounting Bracket [8] ◯ **AM12** - 12" [9] ◯ **AM18** - 18" [9] ◯ **AM24** - 24" [9]	◯ **FE** - Flat Endcap (standard) ◯ **DE** - 1" Drop Endcap [10] ◯ **OE** - Open Endcap [11]	◯ **SW** - Signal White (standard) ◯ **FB** - Finelite Black [12] ◯ **SA** - Satin Aluminum [12] ◯ **####** - RAL Color Code [12] _____

OTHER OPTIONS

Emergency Style (Optional)	Integrated Sensor (Optional)	Special Options (Optional)
◯ **FAC CHO** - Factory Choice Battery Back-up ◯ **EM/GEN** - Emergency to Generator ◯ **NL** - Night Light ◯ **BSL310LP** - Bodine Battery Back up Low Profile ◯ **GTD** - Generator Transfer Device	◯ **OBO** - Occupancy [1] ◯ **OBD** - Daylight [1] ◯ **OBE** - Enlighted [1, 13] ◯ **W601** - Wattstopper [14] Wireless Sensor ◯ **REE** - Remote Enlighted [15]	◯ **RLA** - Red List Approved ◯ **RLD** - Declared

[1] Not available for Wall Wash
[2] D & ID Regressed only
[3] Not available with regressed
[4] Contact factory for switching options
[5] Indirect/Direct only
[6] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[7] B & V outputs only
[8] Wall Mount only
[9] Arm Mount only
[10] 1" Drop Down Lens downlight only
[11] Available with Hollowed Ellipse Louver (**LHE**) only
[12] 20 business days lead time for color
[13] Enlighted components installed by Finelite, provided by others
[14] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.
[15] Enlighted for Wall Wash fixtures. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS[1]: Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, 1" Drop Down Lens[2], Regressed Diffuser, or White Cross Blade Baffle[3]. Corners not available with Wall Wash (**WW-D**), Hollowed Ellipse Louver (**LHE**) or Hex Louver (**LHC**). Contact factory for Double miters using the White Cross Blade Baffle. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

UPLIGHT OPTION[4]: Patented Top Glow frost white diffuser standard. 12' maximum diffuser length. 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination Optional: Flush frost white snap-in diffuser, 73% transmissive, 99% diffusion; **ASY-L** distributes light to the left, **ASY-R** distributed light to the right of the luminaire. Consult factory for more tailored lumen outputs.

DOWNLIGHT OPTION[5]: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), Bottom Glow (**BG**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**)[6], Hollowed Ellipse Louver (**LHE**)[6], Hex Louver (**LHC**)[6], Downlight Asymmetric Optic (**DAO**)[7], and Regressed downlight diffusers (**RG**). 1" Drop Down Lens made of highly efficient acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Asymmetric Optic is an extruded lens with a subtle ribbed appearance providing an asymmetric distribution for improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Wall Mount: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white power coat paint. **Arm Mount**: The standard Signal White (**SW**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL FEATURES

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed controlling uplight and downlight together (power and dimming). Specify dual feeds for independent control of uplight and downlight. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:
- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))
- **LUT-2W (LTEA2W)** - (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime.:** 100,000 hours
- **FineTune DMX:** 1%

[1] Not available with Wall Wash
[2] Indirect/Direct and Direct only
[3] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[4] Wall Mount Indirect/Direct, Wall Mount Regressed Indirect/Direct, and Wall Mount Indirect only
[5] Wall Mount Indirect/Direct, Wall Mount Regressed Indirect/Direct, Wall Mount Direct, and Wall Mount Regressed Direct only
[6] Wall Mount Regressed Indirect/Direct & Wall Mount Regressed Direct only
[7] Not available with Regressed

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SPECIFICATIONS

LUTRON TUNABLE WHITE DRIVER OPTION: LUT-TW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE: Wall Mount: Luminaire hangs securely from mounting brackets fastened directly to the wall for easy installation. Luminaire stands 1/2" off the wall. The mounting bracket is concealed behind the luminaire. **Arm Mount**: bracket mounts directly to wall j-box, extends luminaire 12", 18", or 24" from wall. Other lengths available. Consult factory.

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of luminaire runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER OPTIONS

ENDCAPS: Flat diecast aluminum endcaps (**FE**) add 1/4" to each end of luminaire. 1" Drop Down Lens Endcap (**DE**)[8] includes diffuse element to continue luminance of drop lens. Open Endcap (**OE**) is for use with the Hollowed Ellipse Louver (**LHE**); following the curve of the louver.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery. Factory choice low-profile backup battery available. 8' minimum luminaire length for low profile battery pack.
- **Indirect/Direct:** backup batteries deliver 1608 lumens. 12' minimum luminaire length. 2' illuminated (downlight standard).
- **Direct:** backup batteries deliver 1608 lumens. 8' minimum luminaire length. 2' illuminated.
- **Indirect:** backup batteries deliver 1874 lumens. 8' minimum luminaire length. 2' illuminated.
- **Wall Wash:** backup batteries deliver 1500 lumens. 8' minimum luminaire length. 2' illuminated.

Tunable White ELECTRICAL OPTIONS[9]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) occupancy or daylight sensors available with Flush and Bottom Glow downlight diffusers. Refer to Occupancy Sensor, Daylight Sensor, and Enlighted Sensor tech sheets for more info.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**)[10], and Satin Aluminum (**SA**)[10] are standard. Optional Adder: 185 RAL colors[10] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These fixtures are rated for Damp Location. HP-2 can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT[11]: ID - 2.9 lb/ft; D - 2.3 lb/ft; I - 2.3 lb/ft; AM - 2.9 lb/ft (luminaire only)

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

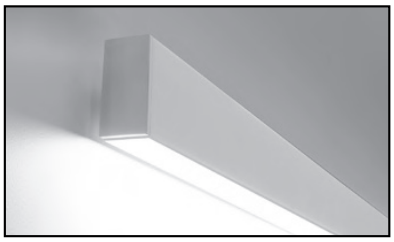
[8] Available in Indirect/Direct Regressed & Direct Regressed only
[9] Consult Finelite for Generator Transfer Device and Battery Back up fit
[10] 20 business days lead time for color
[11] Excludes Battery Back up and Generator Transfer Device weight

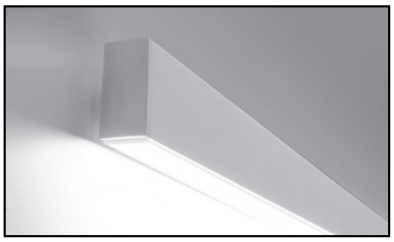
Submitted by:	Date:
Type:	Project:
Ordering Info:	

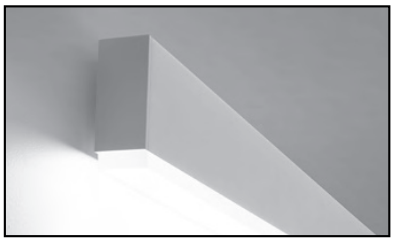
FINELITE® Better Lighting

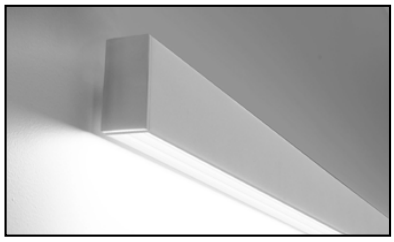
High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

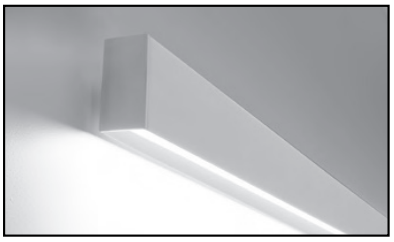
AESTHETIC OPTIONS

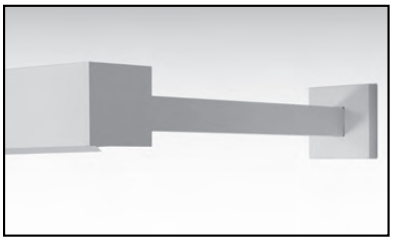

Flush Diffuser (**F**)

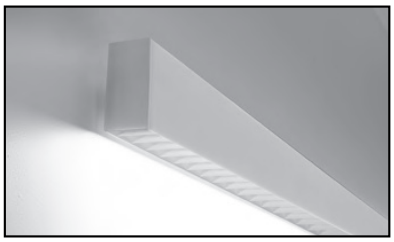

Bottom Glow Diffuser (**BG**)

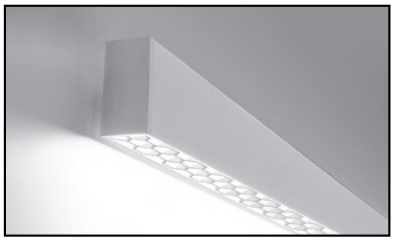

1" Drop Down Lens (**DL**)

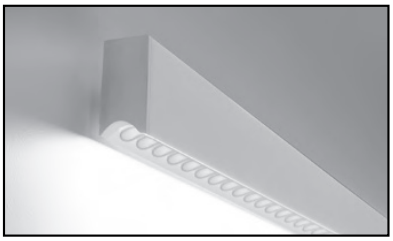

Downlight Asymmetric Optic (**DAO**)[1]
Externally flush


Flat Diffuser with 1" Regressed (**RG-D**)


Kicker (**K**) - Wall Wash Arm Mount only


White Cross Blade Baffle[2] (**RG-WCB**)


Hex Louver[2] (**RG-LHC**)


Hollowed Ellipse Louver[2] (**RG-LHE**)

[1] With a subtle ribbed appearance providing an asymmetric distribution
[2] Regressed only

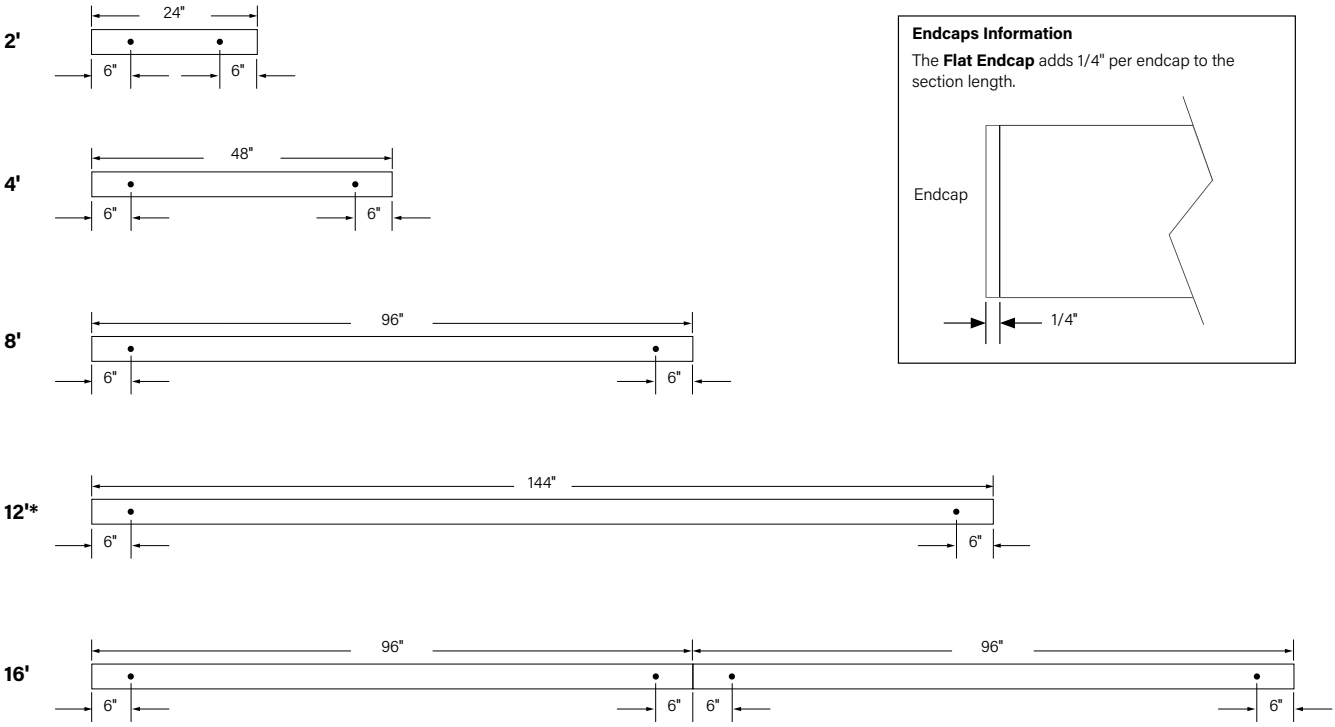
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

WALL WASH ARM MOUNT - Run Lengths & Mounting Location Examples

Tailored Lengths Available Down To 1/16" (±1/32")



Endcaps Information

The **Flat Endcap** adds 1/4" per endcap to the section length.

• = Bracket Location
* = 12' Maximum spacing for two Arm Mount supports

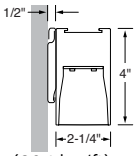
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

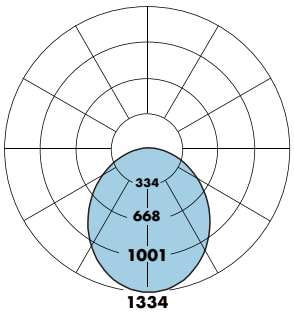
High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

Direct Photometry - 4' Luminaire 3500K

HP2-WM-D-4'-V-835
Downlight: Flush Diffuser



Efficacy: 87 lm/W
Total luminaire output: 3215 lumens (804 lm/ft)
36.9 watts (9.2 W/ft)
Peak Candela Value: 1334 @ 0º
CRI: 80 / CCT: 3500K
ITL LM79 Report 85136



CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	FLUX
0	1334	1334	1334	1334	1334	
5	1327	1326	1326	1325	1324	126
15	1236	1252	1251	1244	1236	352
25	1133	1117	1109	1088	1075	508
35	958	942	923	896	887	576
45	762	747	725	697	686	558
55	563	551	532	509	500	475
65	374	365	351	337	331	349
75	206	201	195	188	184	207
85	62	61	59	57	57	66
90	0	0	0	0	0	

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B [1]**	**H [1]**	**V [2]**
1316	1655	2501	3215

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
329	414	625	804

Power, 3500K (Watts Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
3.6	4.6	7.1	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B [1]**	**H [1]**	**V [2]**
91	90	88	87

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 2501 lm x 0.789 = 1973 lm

Total Light Output per Foot: 625 lm/ft x 0.789 = 493 lm/ft.

watts/foot: 7.1 W/ft.

$$\textbf{Efficacy} = \frac{493\ \frac{\text{lm}}{\text{ft.}}}{7.1\ \frac{\text{W}}{\text{ft.}}} = 69\ \text{lm/W}$$

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85136

Prestige™ Thin Die-Cast Series

Die-cast aluminum slim profile exit sign with long-lasting LED performance

Construction
- Die-cast aluminum
- 6 inch EXIT lettering legend, available in red or green
- Choice of finishes: all white or black with brushed aluminum faceplate: Field-selectable chevrons

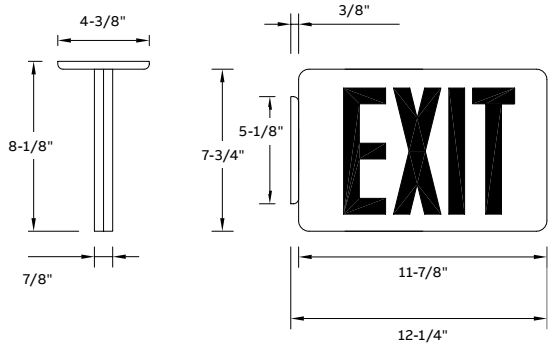
Mounting
- Surface mount
- Canopy included for end or ceiling mount applications: Universal J-box mounting

Approvals
- UL 924 listed
- Damp location 50°F to 104°F (10°C to 40°F)
- Meets NFPA101 (Life Safety Code), NFPA 70-NEC and OSHA illumination standards
- Compatible with Emergi-Lite Min Inverters (contact your sales representative for more information)

Warranty (subject to proper installation and maintenance)
- Unit has a three-year warranty
  Detailed warranty terms located on page 202 or online at: **www.emergi-lite.com/usa/files/EL_Warranty.pdf**

DISTRIBUTOR SELECT

Dimensions
Dimensions are approximate and subject to change.



Faceplate

White | Brushed aluminum

Power consumption

Model			AC specs		DC specs
AC-only	120/277 VAC, 60Hz	Typical 1W	**Less than 1.5W**	–	–
Self-powered	120/277VAC, 60Hz	Typical 1W	**Less than 1.5W**	Ni-Cd battery	Min. 90 minutes

Accessories (order as a separate item)

Description	Suffix
Wire guard (wall mount)	WG1-E
Wire guard (ceiling mount and end mount)	WG5-E

How to order

Frame color/ Face plate	Series	No. of lamps	Legend color
BA= Black body/brushed aluminum face **WW**= White/white	**TX**= AC only **TXN**= Self-powered unit (90 min.)	**1**= Single face **2**= Double face	**R**= Red **G**= Green

Example: BATXN1R

Prestige™ Thin Die-Cast Series

Die-cast aluminum slim profile exit sign with long-lasting LED performance

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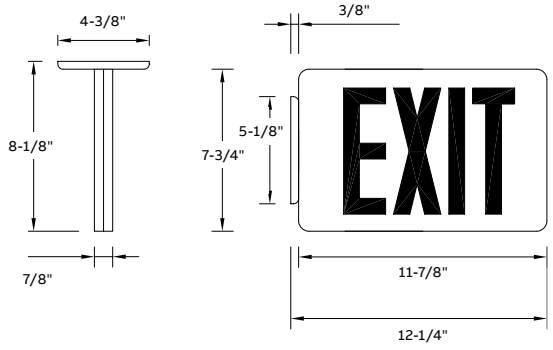

Faceplate

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Example: BATXN1R

PLUMBING FIXTURE CUTSHEETS

TOTO®

WC-1 and WC-2
(or equal product)

CT708U(G)

Commercial Flushometer Top Spud Wall-Hung Toilet – 1.0/1.28/1.6 GPF

FEATURES

- Wall-mounted
- Elongated front bowl
- Optional CeFiONtect™ glaze prevents debris from sticking to ceramic surfaces, making them easier to clean
- Clear glazed trapway coating

MODELS

- CT708U
  Commercial wall-mounted toilet with 1-1/2' top spud inlet, less seat
- CT708UG
  Commercial wall-mounted toilet with 1-1/2' top spud inlet, less seat with CeFiONtect ceramic glaze

ADDITIONAL ITEMS

- SC534 seat
- SC134 seat
- THU111 Retro-fit mounting bolt cap set (4 pcs)

FLUSH VALVES			
ECOPOWER®		**MANUAL**	
Exposed		**Exposed**	
*TET1UA32#CP	1.0 GPF	TMT1LN32#CP	1.28 GPF
*TET1LA32#CP	1.28 GPF	TMT1NNC-32	1.6 GPF
TET1GA32#CP	1.6 GPF		
Exposed 24" Breaker			
*TET6UA32#CP	1.0 GPF		
*TET6LA32#CP	1.28 GPF		
TET6GA32#CP	1.6 GPF		
Concealed 14" x 12"			
*TET2UA32#CP	1.0 GPF		
*TET2LA32#SS	1.28 GPF		
TET2GA32#SS	1.6 GPF		
Concealed 4" x 4"			
*TET3UA32#SS	1.0 GPF		
*TET3LA32#SS	1.28 GPF		
TET3GA32#SS	1.6 GPF		

**WaterSense listed*

Flush valve sold separately

CeFiONtect

COLORS/FINISHES

- Standard
  #01 Cotton

PRODUCT SPECIFICATION

The wall-mounted, low consumption siphon jet flushing toilet shall be 1.0, 1.28, or 1.6 GPF (3.8, 4.8, or 6.0 LPF) when paired with a flush valve of corresponding flush volume. Toilet shall have optional CeFiONtect ceramic glaze. Toilet can be mounted at ADA height. Toilet shall be TOTO Model CT708U_____.

CODES/STANDARDS

- Meets and exceeds ASME A112.19.2/CSA B45.1
- Certifications: IAPMO(cUPC), State of Massachusetts, City of Los Angeles, and others
- Code compliance: UPC, IPC, NSPC, NPC Canada, and others
- ADA compliant

To complete a WaterSense listed combination, the bowl must be paired with a flush valve which is EPA WaterSense listed.

CT708U(G)

WC-1 and WC-2
(or equal product)

Commercial Flushometer Top Spud Wall-Hung Toilet – 1.0/1.28/1.6 GPF

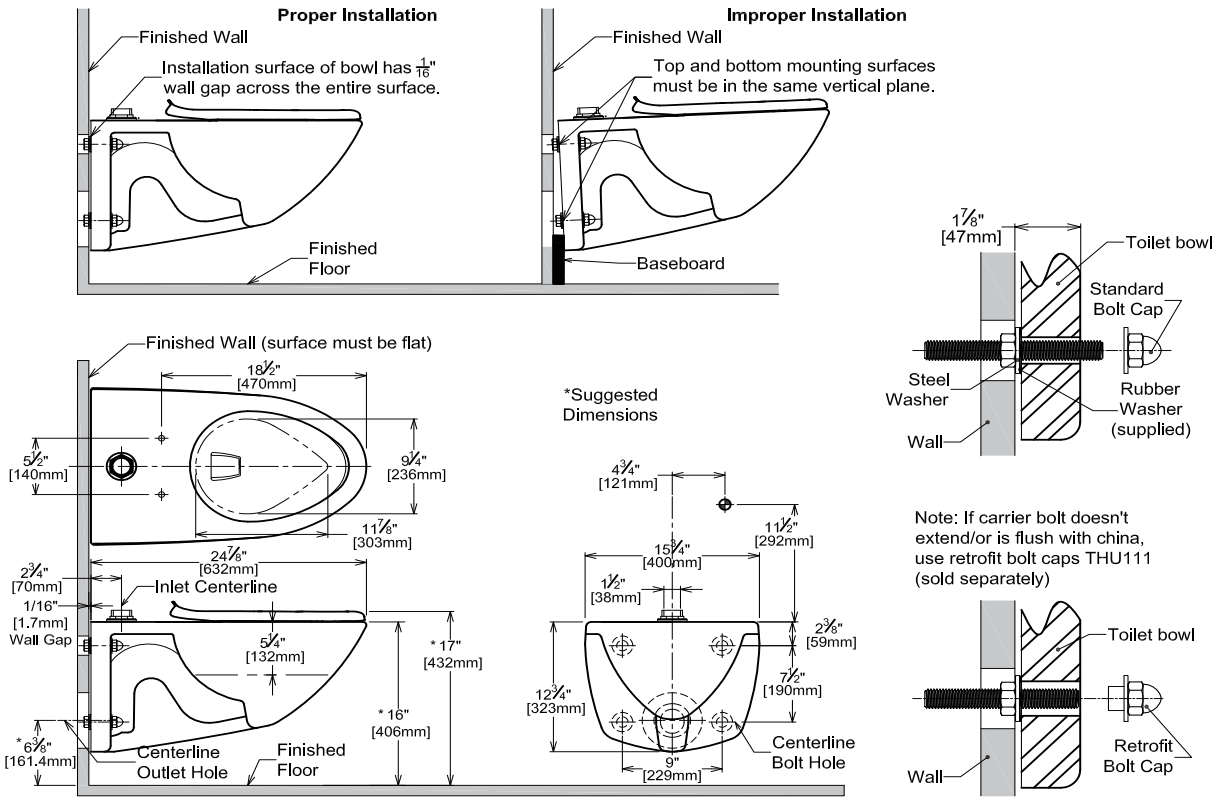
SPECIFICATIONS

Water Use	1.0/1.28/1.6 GPF (3.8/4.8/6.0 LPF)
Flush System	Siphon Jet Flushing Action
Water Surface	12" x 9-1/4"
Water Pressure	Min: 35 psi (Flowing) Max: 80 psi (Static)
Min. Flow Rate	24 GPM
Trap Diameter	2-1/8"
Trap Seal	2-5/8"
Material	Vitreous China
Warranty	One Year Limited Warranty
Shipping Weight	56 lbs
Shipping Dimensions	26-1/4"L x 15-5/8" W x 16"H

INSTALLATION NOTES

Spuds are unique for TOTO product. For replacement spuds, contact TOTO for part number THU073R

DIMENSIONS



TOTO®

WC-1 and WC-2
(or equal product)

TET1LA

ECOPOWER® High-Efficiency Toilet Flush Valve, 1.28 GPF

FEATURES

- 1.28 GPF
- Self-powered hydroelectric flush valve system
- No minimum daily usage requirement
- Durable chrome plated body with tamper-proof screws and solid bronze valve body
- Self-cleaning piston valve with 360° filter screen
- Neutral rough-in and adjustable tail piece connection
- True mechanical flush override
- Smart sensor with self-adjusting detection range
- 6-second detection time to prevent ghost flushing
- For toilet with 1-1/2" top spud inlet
- Exposed flush valve with 1" angle stop and 1-1/2" vacuum breaker set
- ADA compliant

ECOPOWER

Auto Flush

Piston Valve

MODELS

☐ TET1LA32#CP
- TET1LAR#CP (1.28 GPF flush valve)
- VB0932#CP (1-1/2" vacuum breaker tube, 1" angle stop)

COLORS/FINISHES

- #CP Polished Chrome

OPTIONAL ACCESSORIES

- Z-4000-J - Adapter for ground joint angle stops

CODES/STANDARDS

- Meets or exceeds ASSE 1037, CSA B125.3
- Certifications: IAPMO(cUPC), EPA WaterSense, ASSE, State of Massachusetts, and others
- Code Compliance: UPC, IPC, NSPC, NPC Canada, and others
- Complies with CA Title 20 regulations and CalGreen when used with a 1.28 GPF water closet
- ADA compliant
- Complies with CA Prop 65 warning requirements

CALGreen

PRODUCT SPECIFICATION

TOTO® Model No. _____
Product shall be 1.28 GPF. Product shall be an automatic infrared sensor-activated, toilet flush valve. Product shall use hydropower, ECOPOWER flush valve system. Product shall have durable chrome plated body with tamper-proof screws and solid bronze valve body. Product shall have smart sensor with self-adjusting detection range. Product shall have neutral rough-in and adjustable tail piece connection Product shall have smart sensor with self-adjusting detection range. Product shall have true mechanical flush override. Product shall have 6-second detection time to prevent ghost flushing. Product shall have piston with debris screen and solenoid with self-cleaning mechanism. Product shall be ADA compliant.

TET1LA

WC-1 and WC-2
(or equal product)

ECOPOWER® High-Efficiency Toilet Flush Valve, 1.28 GPF

SPECIFICATIONS

- Material — Bronze casting
- Power supply — ECOPOWER
- Sensor detection time — Factory setting at six (6) seconds minimum
- Sensor detection range — Self-adjusting to environment
- Discharge quantity — Preset to 1.28 GPF/ 4.8 LPF
- Operating temperature — 32°-104°F (0°-40°C)
- Water supply pressure — 35 psi - 125 psi*
- Water supply connection — 1" NPT
- Warranty — Three year limited

*Water pressures over 80 psi are not recommended for most plumbing fixtures. Check your local plumbing code for details.

INSTALLATION NOTES

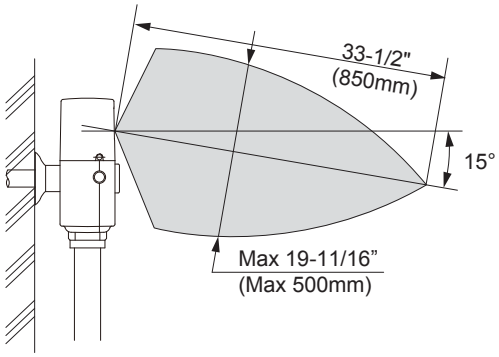
For commercial applications only.
Warning: Failure to properly adjust angle stop to the appropriate level can potentially cause property damage.

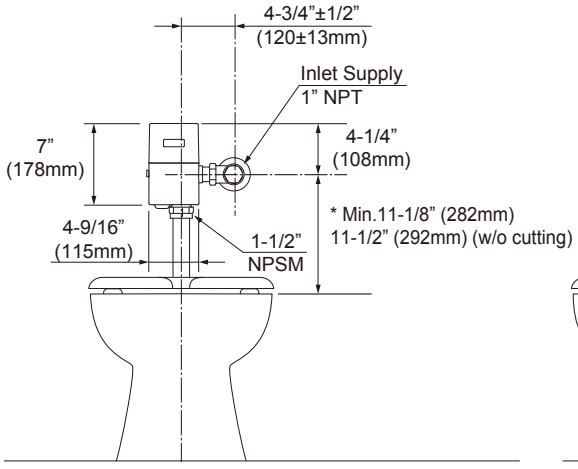
For detailed installation instructions, please refer to the installation manual.

Max flow rate to be used with
TET1LA_____: 1.28 GPF

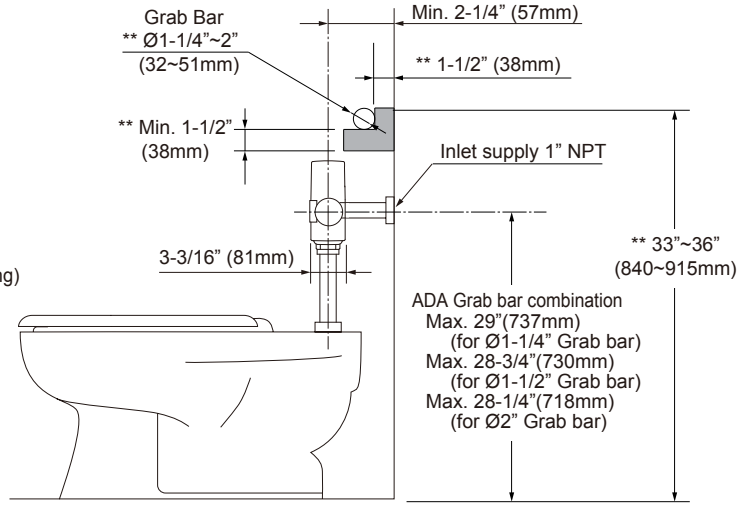
Confirm with local codes and standards for floor drain requirement. Adjust control stop for proper flow rate to the fixture.

DIAGRAM





* Check local codes



** ADA 2010 Section 609

TOTO®

These dimensions and specifications are subject to change without notice

L-1
(or equal product)

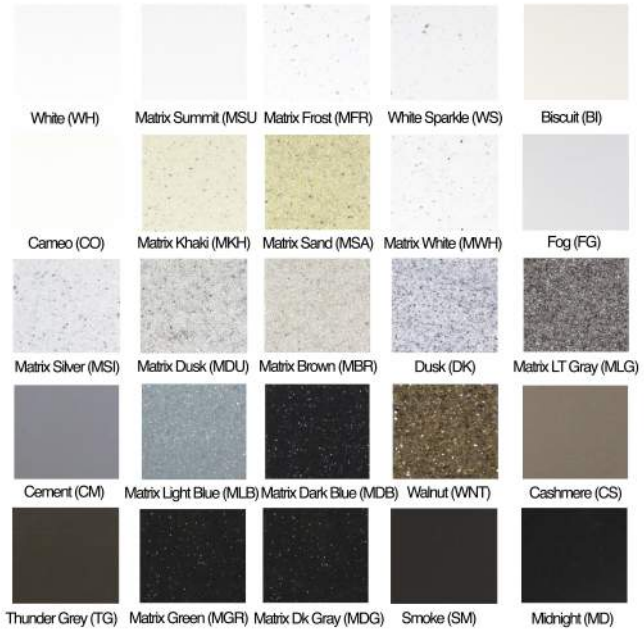
SLOANSTONE® SINK
ELGR-82000

DESCRIPTION
SloanStone® 2-Station Wall-Mounted Gradient Sink.

DETAILS
- Material: SloanStone
- Height: 127" (3,226mm)
- Width: 60" (1,524mm)

FEATURES
Two Station Lavatory System with the following features:

- Dimensions: 60” x 22” x 5”
- A Monolithic deck fabricated from Sloanstone® solid surface
- Available in 25 colors
- Multiple Mounting Options
- Pairs great with Sloan faucets and soap dispensers

COLORS


RECOMMENDED SPECIFICATION
SloanStone Series Sink model no. ELGR 8X000 Gradient Style Sink. Product to be molded using SloanStone solid surface. Sloan automated sensor faucet. Sloan sensor operated foam soap dispenser. Sink design to be ADA compliant and IAPMO certified. Supplied with either angle brackets or enclosure.

DOWNLOADS
- ELGR-80000 Series Installation Instructions
- ELGR-80000 Series Repair and Maintenance Guide
- Additional Downloads

NOTES
All information contained within this document subject to change without notice.

Looking for other variations of the ELGR-82000 product? View the general spec sheet with all options.

Find a compatible faucet for this sink.
Find a matching soap dispenser for this sink.

SUGGESTED FAUCETS

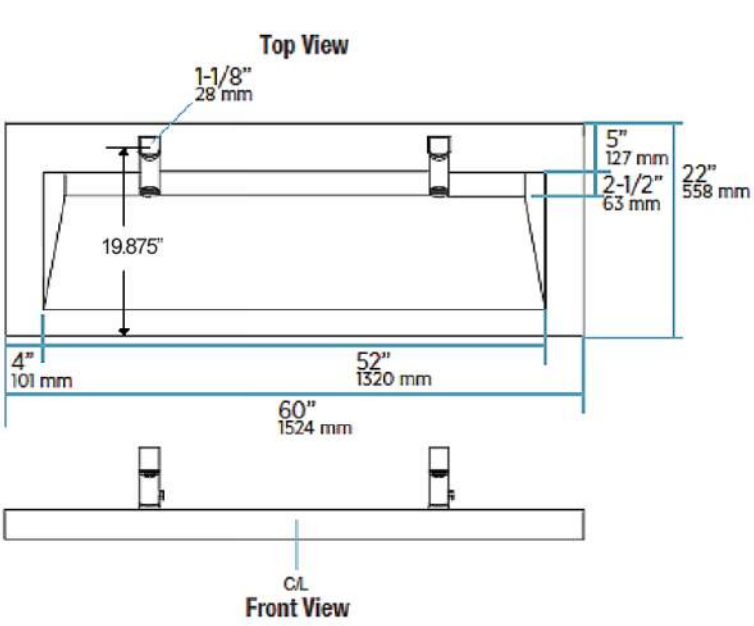
	Name	Description
	EAF-150	View more info
	EAF-100	View more info

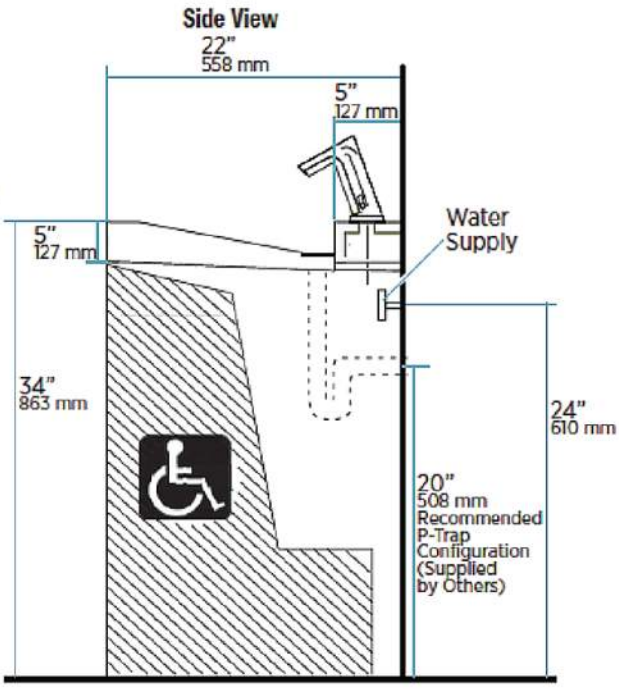
Sloan 10500 Seymour Ave, Franklin Park, IL 60131
Phone: 800.982.5839 • Fax: 800.447.8329 • sloan.com

SUGGESTED SOAP DISPENSERS

	Name	Description
	ESD-1500	View more info

ROUGH-IN





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Phone: 800.982.5839 • Fax: 800.447.8329 • sloan.com

SF-2450-4-BAT-TEE-CP-0.35GPM-MLM-IR-FCT

(General Model Name: SF2450-4 CP FCT PEDESTAL 4" BATTERY 0.35 GPM)

L-1
(or equal product)

CODE NUMBER

3362172

DESCRIPTION

4" Trim Plate, Battery Power Supply, Back-Check Tee, Polished Chrome Finish, 0.35 gpm, Multi-Laminar Spray, Infrared Sensor, Sloan® Battery-Powered Deck-Mounted Mid Body Faucet.

DETAILS

- Flow Rate: 0.35 gpm (1 Lpm) (0.35GPM)
- Spray Type: Multi-Laminar (MLM)
- Spout Type: Pedestal ()
- Sensor Type: Infrared (IR)
- Mounting Type: Single Hole ()
- Trim Plate: 4" (102mm) (4)
- Power Supply: Battery (BAT)
- Temperature Mixer: Back-Check Tee (TEE)
- Finish: Polished Chrome (CP)
- Factory Default Timeout: 30s
- Factory Default GPC: 0.175

FEATURES

Commercial Grade, ADA Compliant, Electronic, Sensor-Activated, Brass Pedestal Hand Washing Faucet with the following features:

- Adjustable Infrared Sensor Range
- 36” (914 mm) Long Sensor Cable
- 24” (610 mm) Long Flex Hose
- Filtered Solenoid Valve with serviceable Strainer Filter
- Includes Four (4) AA-size Batteries
- Includes appropriate Mounting Hardware

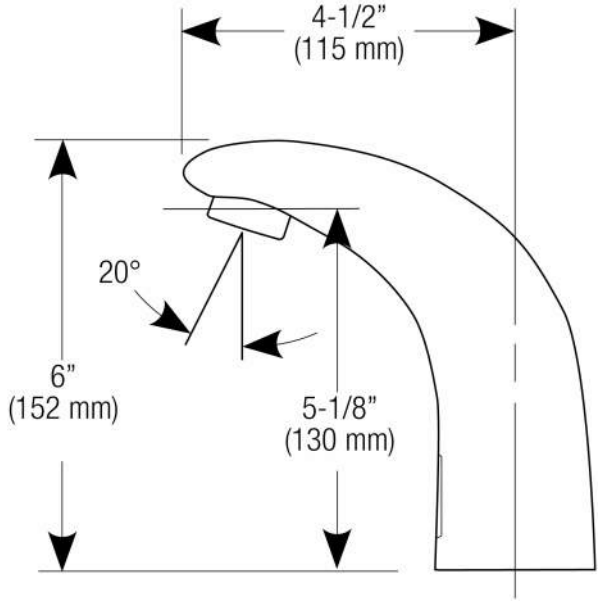
ELECTRICAL SPECIFICATIONS

- Battery Life: 2 years 8,000 cycles/month
- Sensor Range: 4"–12" (102–305mm)
- Timeout Adjustment Settings: 30s

DOWNLOADS

- SF Series Installation Instructions
- SF Series (FR) Installation Instructions
- SF Series (SP) Installation Instructions
- SFP 35-A Installation Instructions
- Trim Plate Guide
- Sloan 2400/2450 Repair and Maintenance Guide
- Additional Downloads

Variation not shown: 4" Trim Plate



COMPLIANCES & CERTIFICATIONS

(ADA Compliant, ASME A112.18.1 Compliant, BREEAM Water Credit, CalGreen Compliant, CEC Compliant, cUPC Certified, cUPC Low Lead Compliant, Green Globes Water Credit, NYC604.4, Proposition 65, Satisfies LEED Credits, TAS, UPC Certified, UPC Low Lead Compliant)

NOTES

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Looking for other variations of the SF-2450 product? View the

Sloan 10500 Seymour Ave, Franklin Park, IL 60131
Phone: 800.982.5839 • Fax: 800.447.8329 • sloan.com

L-1
(or equal product)

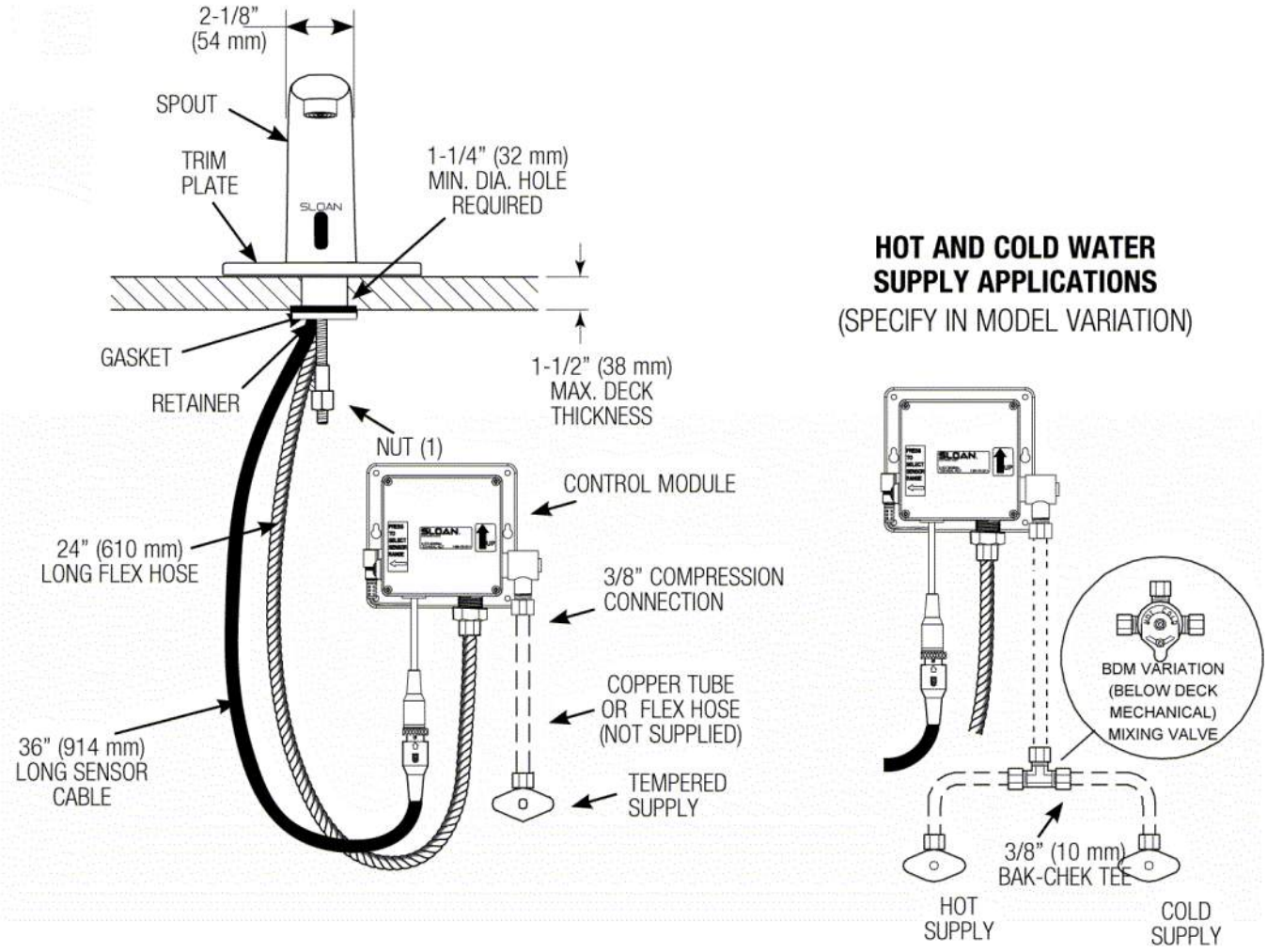
general spec sheet with all options.

Find a matching soap dispenser for this faucet.
Find a compatible sink for this faucet.

WARRANTY

1 Year

ROUGH-IN



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L-1
(or equal product)

OPTIMA® ACCESSORY
0326045PK

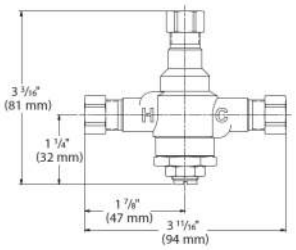
CODE NUMBER
0326045PK

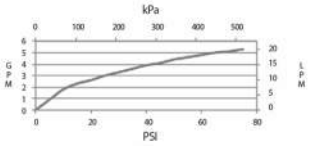
DESCRIPTION
Thermostatic mixing valve supplied with Sloan Optima® and Optima Plus® faucets that are specified with the “BDT” (Below Deck Thermostatic) variation, or available separately.

FEATURES
MIX-135-A Thermostatic Water Mixing Valve with the following features:

- Designed for under-the-lavatory applications where the outlet temperature of hot water must be controlled for safe, economic use.
- Installs in place of the Tee fitting supplied with the faucet prior to the solenoid valve
- Designed to quickly sense and compensate for temperature fluctuations induced by water temperature and pressure changes in the supply line
- Rugged construction features solid brass valve body and corrosion resistant internal components
- Water temperature adjustment stem with lock nut to prevent tampering
- Equipped with integral check valves at inlets
- 3/8” compression connection on inlets and outlet
- Meets all the performance standards of ASSE 1070 and CSA B125
- Capacity — standard: 4.0 gpm (15.0 Lpm)
  - At 45 PSI differential (310 kPa), with hot water supply between 140°-180° F (60°-82° C).
- Maximum Hot Water Supply Temperature: 180° F (82° C)
- Minimum Hot Water Supply Temperature: 5° F (2.8° C) above set point
- Maximum Operating Pressure:125 psig (862kPa)
- Minimum flow — standard: 0.25 gpm (1.0 Lpm) to ASSE 1016
- Factory set: 105° F (40° C)

NOTES
All information contained within this document subject to change without notice.





COMPLIANCES & CERTIFICATIONS
(ASSE 1070, UPC Low Lead Compliant)

DOWNLOADS
- Additional Downloads

Sloan 10500 Seymour Ave, Franklin Park, IL 60131
Phone: 800.982.5839 • Fax: 800.447.8329 • sloan.com

TOTO®

L-2
(or equal product)

LT308

Wheelchair Users Lavatory

FEATURES

- 20-1/2" x 27"
- Vitreous china
- ADA compliant
- Punching for concealed arm carrier
- No hardware included

MODELS

- LT308
  Lavatory only, with single hole
- LT308.4
  Lavatory only with 4" faucet centers
- LT308.11
  Lavatory only with 11" faucet centers
- LT308A
  Lavatory only with single hole. Right side soap hole
- LT308.4A
  Lavatory only with 4" faucet centers. Right side soap hole
- LT308.11A
  Lavatory only with 11" faucet centers. Right side soap hole.

COMPONENTS

- THP5067#CP (Sold Separately)
  Grid drain 1-1/2" opening with 4" tail piece

COLORS/FINISHES

- Standard
  #01 Cotton

CODES/STANDARDS

- Meets and exceeds ASME A112.19.2/CSA B45.1,
- Certifications: IAPMO(cUPC), State of Massachusetts , City of Los Angeles, and others
- Meets ADA ,TAS, ICC/ANSI A117.1 and CSA B651
- Code compliance: UPC, IPC, NSPC, NPC Canada, and others

PRODUCT SPECIFICATION

The wall-mount lavatory shall be made of vitreous china. Lavatory shall be 20-1/2"in length and 27" in width. Product shall be with front overflow. Lavatory shall be ADA compliant. Lavatory shall be TOTO Model LT308_____.

L-2
(or equal product)

LT308

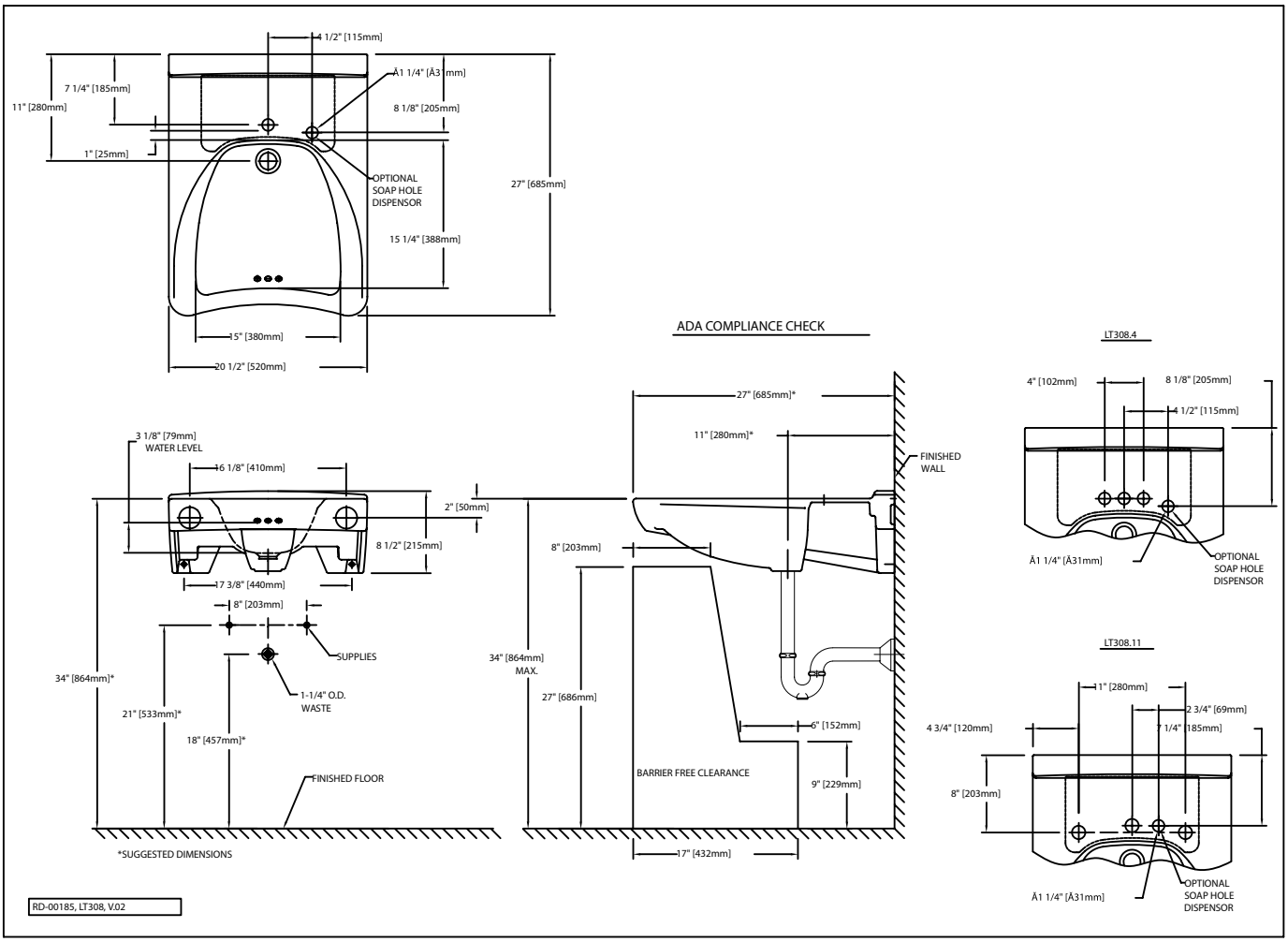
Wheelchair Users Lavatory

SPECIFICATIONS

- Waste 1-1/4" O.D.
- Size 20-1/2"W x 27"D
- Basin 15-1/8"W x 14-3/4"D
- Warranty One Year Limited Warranty
- Material Vitreous china
- Shipping Weight LT308/LT308.4/LT308.11 56 lbs.
- Shipping Dimensions LT308/LT308.4/LT308.11 29-1/8"L x 22-7/8"W x 10-5/8"H

INSTALLATION NOTES

TOTO recommends the use of Jay R. Smith 0700 (- 27 - M31) (Concealed Arms) or equal.



TOTO®

L-2
(or equal product)

TEL103 Series

Standard EcoPower® Faucet

FEATURES

- Self-generating hydropowered EcoPower system
- No minimum daily usage requirement
- Micro-sensor positioned underneath the spout head for accurate hand detection ensuring smooth and consistent water distribution
- Vandal resistant aerator housing
- Durable chrome plated spout body
- Single-hole mount
- Kit includes spout body, controller box, and mounting hardware - less supply lines
- 0.35 gpm aerated flow
- Contributes to earning LEED® credits

MODELS

☐ **TEL103-D20E**
- TELS103 (Standard Spout)
- TELC103-D20E (Controller: 0.11gpc, 20 sec on-demand)

☐ TEL103-D20EM
- **TEL103R-D20E** (Standard Spout Kit)
- TLM10 (Mixing Valve)

☐ **TEL103-D20ET**
- TEL103-D20E (Standard Spout Kit)
- TLT20 (Thermostatic Mixing Valve)

COLORS/FINISHES

- #CP Polished Chrome

OPTIONAL ACCESSORIES

- THP3158#CP - 4" Cover Plate
- THP3159#CP - 8" Cover Plate

PRODUCT SPECIFICATION

TOTO Model #_____ The faucet shall have hydropowered self-generating, EcoPower System. The faucet shall have maximum of 20 seconds on-demand flow (0.11gpc). The faucet shall have self-adjusting sensor. Product equipped with 0.35gpm flow regulator.

EcoPower

CODES/STANDARDS

- Operates below federally mandated consumption limit of 0.25gpc
- Complies to California Green Building Code, CALGreen of 0.20 gpc
- Meets or exceeds ASME A112.18.1M/CSA B125.1, and NSF372-2011
- Certifications: IAPMO(cUPC), State of Massachusetts, and others
- California Green Code and City of Los Angeles Water Efficiency Ordinance
- ADA compliant
- Complies with federal and state statutes as low-lead (contains a weighted average of 0.25% lead or less)

For codes and standards of mixing valves TLM10, please refer to corresponding product spec sheet.

LOW-LEAD

TEL103 Series

L-2
(or equal product)

Standard EcoPower® Faucet

SPECIFICATIONS

Power Supply	Ecopower
Sensor Detection Range	5-1/8" - 7-7/8" (130 - 200mm) Sensor is self-adjusting
Water Supply Pressure	Min (Dynamic/Flowing) Pressure: 15 psi (100kPa) Max (Static) Pressure: 80 psi (551kPa)
Water Supply	G1/2 (1/2 NPSM compatible)
Inlet Temperature Range	32-110°F(0-42°C)
Ambient Temperature	32-104°F(0-40°C)
Humidty	Max. 90% RH
Flow Rate	0.11 gpc* - max 20 second On-Demand** (0.11 gpc = 0.35 gpm x 20/60 sec) Equipped with 0.35 gpm flow control
Warranty	Three years

NOTE

Following the federal mandate for water efficiency outlined in the Environmental Protection Act of 1992, faucets can be rated for water consumption based on two categories: Flow Rate and Water Consumption. TOTO uses the water consumption standard because it is the most accurate method of measuring water use. TOTO faucets also comply with the CALGreen Guideline of water usage.

Water Saving

On-Demand [20 sec.] faucet (0.11gpc)

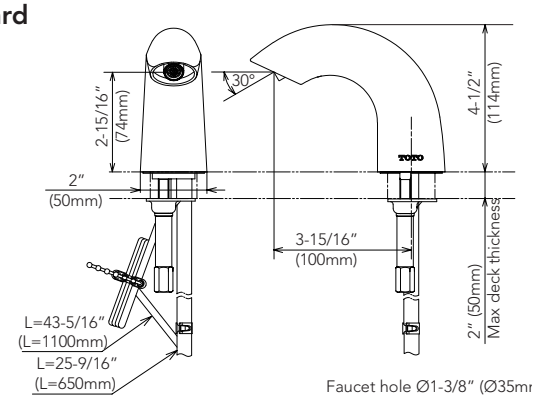
Federal Standard (0.25gpc) –56% less

CAL Green (0.20gpc) – 45% less

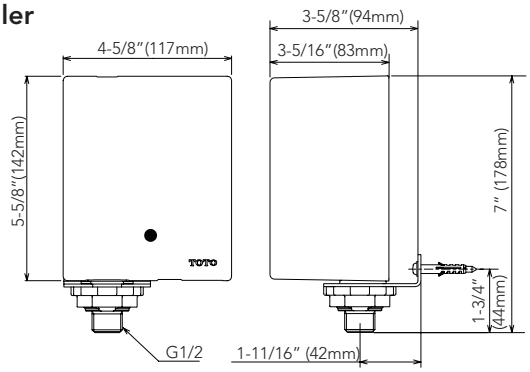
*Gallons per cycle (gpc) is the amount of water per usage cycle .

**On-demand refers to the way in which the water is dispersed (i.e.; water is only dispersed when the sensor is activated by the user as needed).

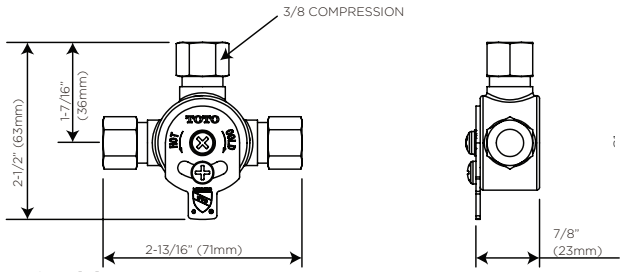
Standard



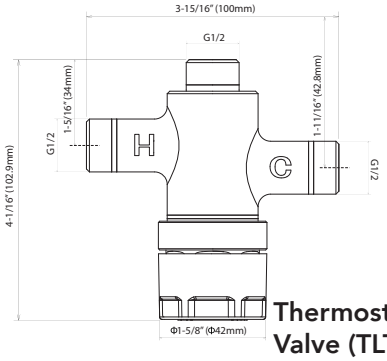
Controller



Available Mixing Valves



Hot/Cold Mixing Tee (TLM10)



Thermostatic Mixing Valve (TLT20)

G1/2 compatible with ½ NPSM

These dimensions and specifications are subject to change without notice

Ph: (888) 295-8134 | Fax: (800) 699-4889 | www.totousa.com | © TOTO USA

#SS-01217 v.04

Pending release date: Fall 2017

TOTO®

L-2
(or equal product)

TLT20

Thermostatic Mixing Valve (For 0.35gpm Lavatory Faucets)

FEATURES

- Below deck thermostatic mixing valve allowing fixed ambient water temperature adjustment
- ASSE approved wax type thermostatic valve to efficiently adjust temperature for ultra-low flow 0.35gpm auto faucet to avoid the outflow of scalding water
- G1/2" (1/2" NPSM compatible) threaded fittings
- Low-lead solid brass construction
- Equipped with integral check valves and debris screens for back flow prevention

OPTIONAL COMPONENTS

- THP3237
  Swivel Coupling

CODES/STANDARDS

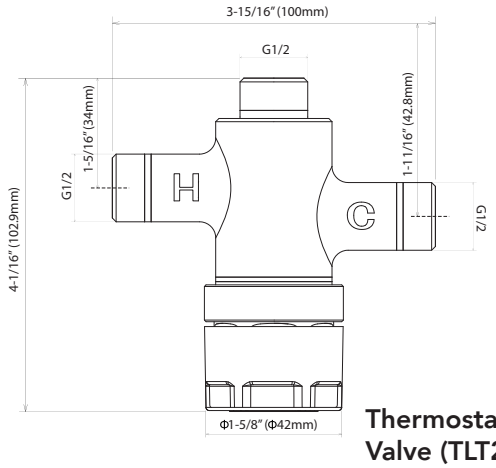
- Meets or exceeds NSF372, ASSE 1070 / ASME A112.1070 / CSA B125.70
- Certifications: IAPMO(cUPC), State of Massachusetts, and others
- Complies with Federal and State statutes as low-lead (contains a weighted average of 0.25% lead or less)
- Complies with CA Prop 65 warning requirements

LOW-LEAD
UPC

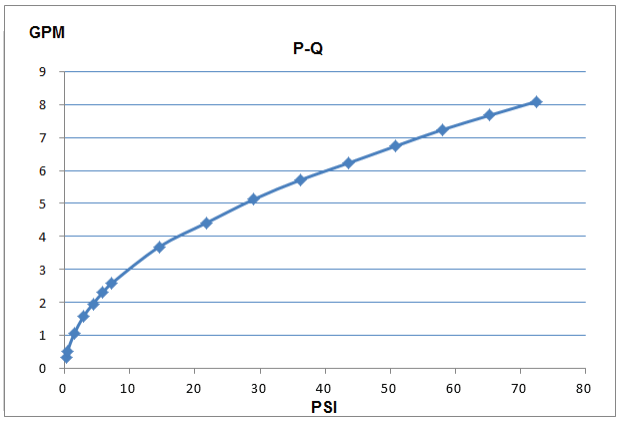
SPECIFICATIONS

Water Supply Pressure	Min (Flowing): 15 psi (100 kPa) Max (Static): 80 psi (551 kPa)
Water Supply Connection	G1/2" (1/2" NPSM compatible)
Ambient Temp.	32 - 104°F (0 - 40°C)
Humidity	Max. 90% RH
Recommended Temp. Range	Hot Supply: 120 - 180°F (49 -82°C) Cold supply 39 - 80°F (4 - 27°C)
Temp. Adjustment Range at Outlet	Ambient water temp~120°F (48.9°C)
Factory Default Outlet Temp.	100±4°F (38±2°C) (Condition: 30psi (206kPA) Ambient water temp and hot water temp 176°F)
Minimum Flow	0.35 gpm (1.3L/min)
Warranty	Three Year Limited
Shipping Weight	1.2 lbs
Shipping Dimensions	4-3/8" x 4-3/16" x 3-9/16"

DIMENSIONS



Thermostatic Mixing Valve (TLT20)
G1/2 compatible with ½ NPSM



ELKAY®
SPECIFICATIONS

Elkay ezH2O Bottle Filling Station & Versatile Bi-Level ADA Cooler Filtered Non-Refrigerated Light Gray
Model LZSTLDDWSLK

PRODUCT SPECIFICATIONS

Elkay ezH2O® Bottle Filling Station & Versatile Bi-Level ADA Cooler, Filtered Non-Refrigerated Light Gray. Features shall include Antimicrobial, Filtered, Green Ticker™, Hands Free, Laminar Flow, Real Drain, Visual Filter Monitor. Furnished with Flexi-Guard ® Safety Bubbler. Electronic Bottle Filler Sensor with Electronic Front and Side Bubbler Pushbar activation. Product shall be Wall Mount (On Wall), for Indoor applications, serving 2 station(s). Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120. Unit shall be lead-free design which is certified to NSF/ANSI 61 & 372 (lead free) and meets Federal and State low-lead requirements.

Special Features:	Antimicrobial, Filtered, Green Ticker™, Hands Free, Laminar Flow, Real Drain, Visual Filter Monitor
Finish:	Light Gray Granite
Power:	115V/60Hz
Bubbler Style:	Flexi-Guard ® Safety Bubbler
Activation by:	Electronic Bottle Filler Sensor with Electronic Front and Side Bubbler Pushbar
Mounting Type:	Wall Mount (On Wall)
Chilling Capacity:	Non-refrigerated
Full Load Amps	1.1
Rated Watts:	15
Dimensions (L x W x H):	36-3/4" x 19" x 39-1/16"
Approx. Shipping Weight:	82 lbs.
Installation Location:	Indoor
No. of Stations Served:	2

Special Note: Installs with stainless steel back panel (1000004920); accessory to enhance design & ease of installation.

- Visual Filter Monitor: LED Filter Status Indicator for when filter change is necessary.
- Filter is certified to NSF 42 and 53 for lead, cyst, particulate, chlorine, taste and odor reduction. 3,000 gal. capacity.
- Green Ticker: Informs user of number of 20 oz. plastic water bottles saved from waste.
- Laminar flow provides clean fill with minimal splash.
- Silver Ion Antimicrobial protection on key plastic components to inhibit the growth of mold and mildew.
- Real Drain System eliminates standing water.

DF-1
(or equal product)

Included with Product: **Water Cooler (LZSTLDDWSLC), Bottle Filler (LZWSR), Filter**

▼ Ships in multiple boxes.

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PRODUCT COMPLIANCE

ADA & ICC A117.1
ASME A112.19.3/CSA B45.4
Buy American Act
CAN/CSA C22.2 No. 120
GreenSpec®
NSF/ANSI 42, 53, 61, & 372 (lead free)
UL 399

Complies with ADA & ICC A117.1 accessibility requirements when installed according to the requirements outlined in these standards. Installation may require additional components and/or construction features to be fully compliant. Consult the local Authority Having Jurisdiction if necessary.

Installation Instructions (PDF)

Electrical components and water system are warranted for 12 months from date of installation. **Warranty pertains to drinking water applications only. Non-drinking water applications are not covered under warranty.**

Warranty (PDF)

PART:_____QTY: _____
PROJECT:_____
CONTACT:_____
DATE:_____
NOTES:_____
APPROVAL:_____

In keeping with our policy of continuing product improvement, Elkay reserves the right to change product specifications without notice. Please visit elkay.com for the most current version of Elkay product specification sheets. This specification describes an Elkay product with design, quality, and functional benefits to the user. When making a comparison of other producers' offerings, be certain these features are not overlooked.

Optional Accessories		
51300C	Elkay WaterSentry Plus Replacement Filter (Bottle Fillers) Spec Sheet (PDF)	
LKAPREZL	Elkay Cane Apron for EZ Gray Spec Sheet (PDF)	
MLP200	In-wall Carrier for Bi-level On-wall Bottle Fillers, Coolers & Fountains Spec Sheet (PDF)	
98551C	WaterSentry Filter Mounting Cover (Gray Granite) Spec Sheet (PDF)	

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IMPORTANT!
INSTALLER PLEASE NOTE :

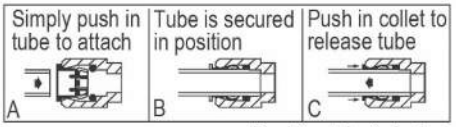
This water cooler has been designed and built to provide water to the user which has not been altered by materials in the cooler waterways. The grounding of electrical equipment such as telephone, computer, etc. to water lines is a common procedure. The grounding may be in the building but may also occur away from the building. This grounding can cause electrical feedback into a water cooler creating an electrolysis which creates a metallic taste or causes an increase in the metal content of the water. This condition is avoidable by installing the cooler using the proper materials as shown below.

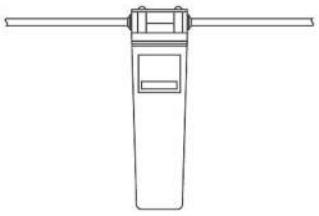
NOTICE

This water cooler must be connected to the water supply using a dielectric coupling. The cooler is furnished with a non-metallic strainer which meets this requirement. The drain trap which is provided by the installer should also be plastic to completely isolate the cooler from the building plumbing system.
Bottle filler unit on bracket attached to wall by 6 holes (as shown). Water and electrical will connect through pre-punched hole in basin.
These products are designed to operate on 20 psi to 105 psi supply line pressure. Simultaneous operation of both bubblers on a bi-level unit may not be possible depending on water supply pressure. If simultaneous operation is desired, please ensure a minimum of 65 psi supply.

DF-1
(or equal product)

OPERATION OF QUICK CONNECT FITTINGS

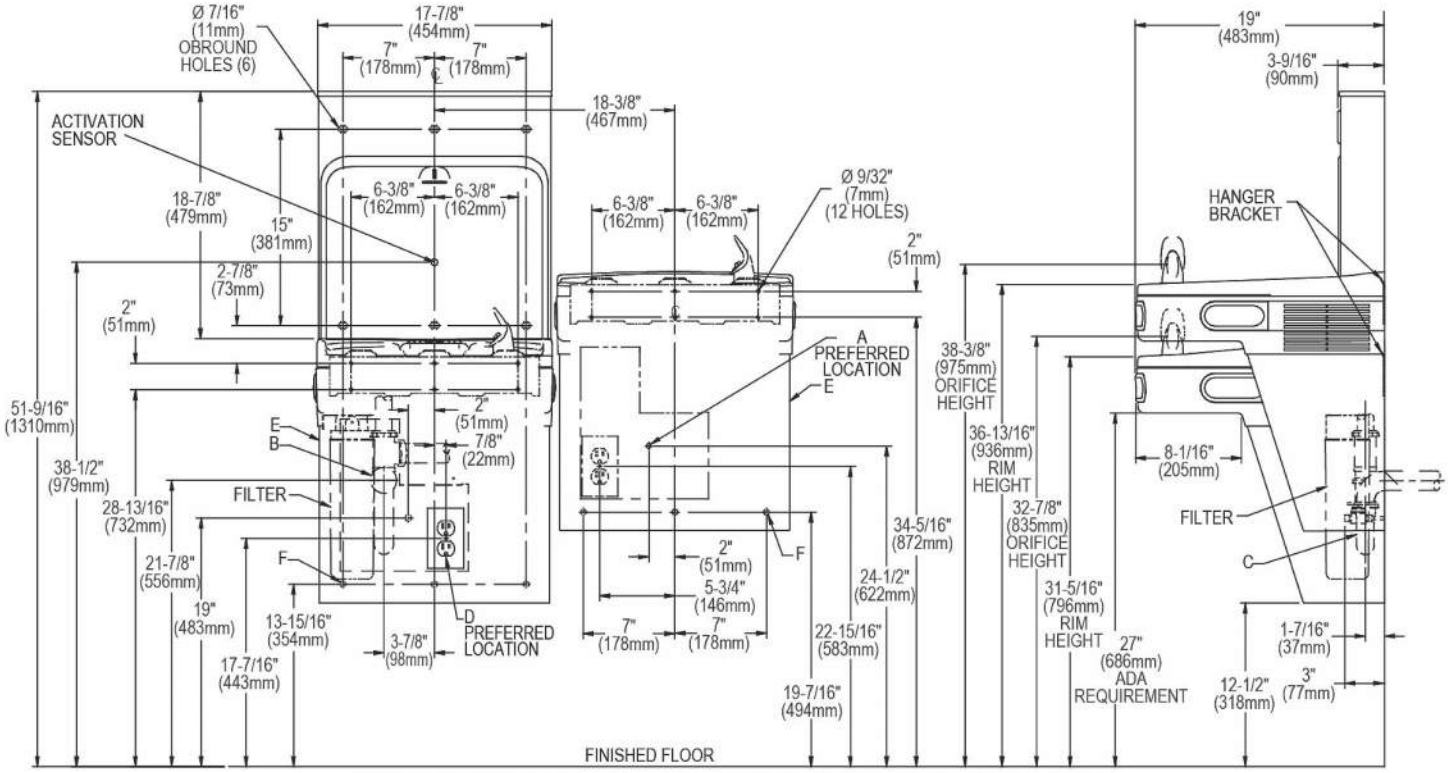




Pushing tube in before pulling it out helps to release tube

WaterSentry® Plus Filter System

ROUGH-IN FOR RIGHT-HAND HIGH SIDE MODELS



REDUCE HEIGHT BY 3 INCHES FOR INSTALLATION OF CHILDRENS ADA COOLER

LEGEND:
A = Recommended Water Supply location. Shut-off Valve (not furnished) to accept 3/8" O.D. unplated copper tube. Up to 3" (76mm) maximum out from wall.
B = Recommended Waste Outlet location. To accommodate 1-1/2" nominal drain. Drain stub 2" (51mm) out from wall.
C = 1-1/2" Trap (not furnished).
D = Electrical Supply (3) Wire Recessed Box Duplex Outlet.
E = Insure proper ventilation by maintaining 6" (152mm) minimum clearance from cabinet louvers to wall.
F = 7/16" (11mm) Bolt Holes for fastening to wall.
Note : New Installations Must Use Ground Fault Circuit Interrupter (GFCI). It is highly recommended that the circuit be dedicated and the load protection be sized for 20 amps.

ELKAY®
SPECIFICATIONS

DF-1
(or equal product)

In-wall Carrier for Bi-level On-wall Bottle Fillers Coolers & Fountains
Model(s) MLP200

PRODUCT SPECIFICATIONS

In-wall Carrier for Bi-level On-wall Bottle Fillers, Coolers & Fountains. Overall dimensions are 38-1/2" x 2-11/16" x 44-1/8". Made of Galvanized Steel.

Material:	Galvanized Steel
Finish:	Black (BK)
Dimensions:	38-1/2" x 2-11/16" x 44-1/8"
Shipping Weight:	54 lbs.

Special Note: For use with bi-level on-wall bottle fillers, coolers & fountains.

- Universal design provides extra support when mounting on-wall bi-level models.
- System can be installed in as little as a 2" x 4" wall.
- Constructed of heavy-gauge steel supporting up to 500 lbs.
- Secures directly to a variety of load-bearing surfaces.
- Adjustable height setting allows for adult or child ADA installation.
- Built in the USA.

Included with Product: **Mounting Carrier Assembly**

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Installation Instructions (PDF)

PART:_____QTY: _____

PROJECT:_____

CONTACT:_____

DATE:_____

NOTES:_____

APPROVAL:

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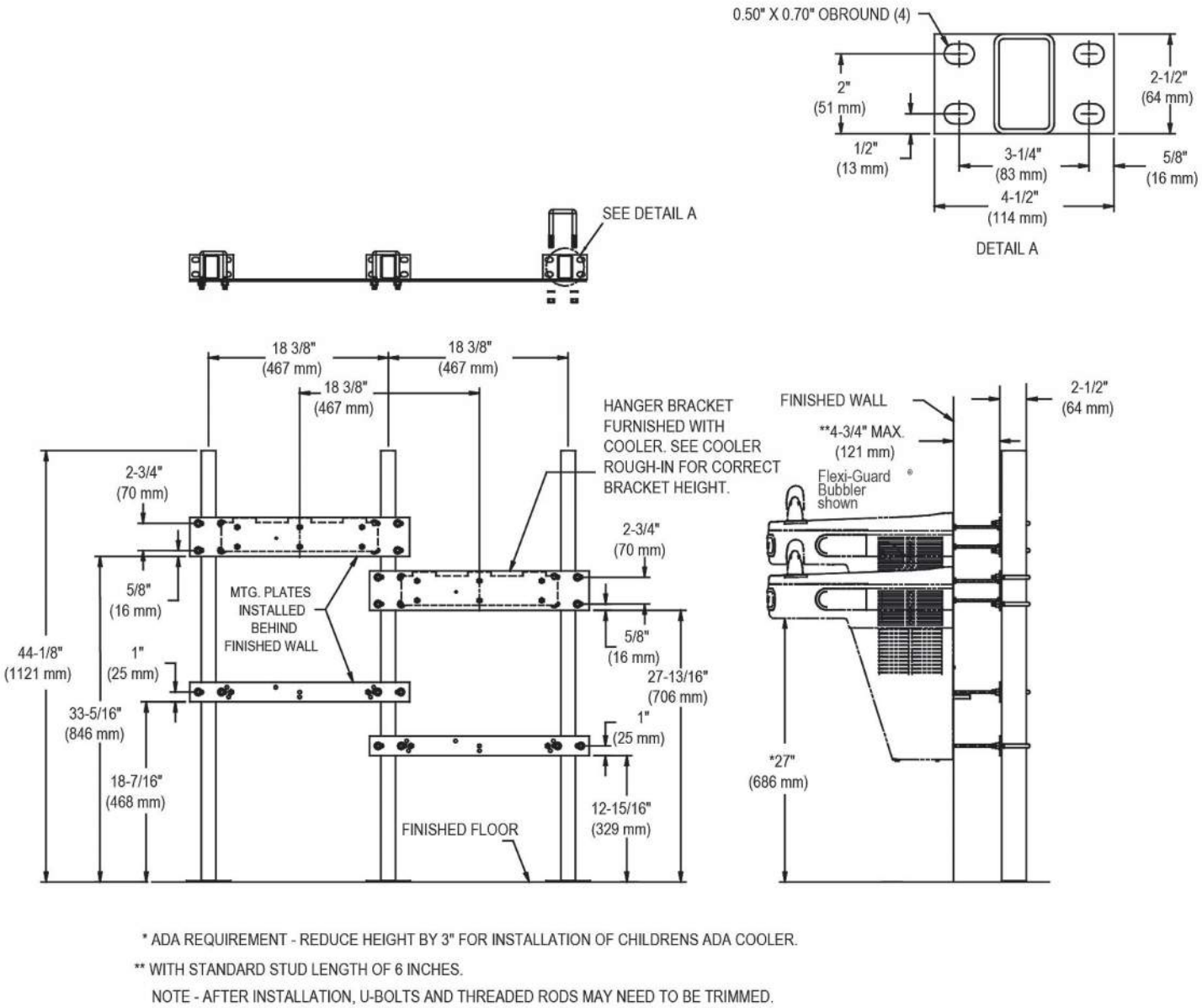
DF-1
(or equal product)



* ADA REQUIREMENT - REDUCE HEIGHT BY 3" FOR INSTALLATION OF CHILDRENS ADA COOLER.

** WITH STANDARD STUD LENGTH OF 6 INCHES.

NOTE - AFTER INSTALLATION, U-BOLTS AND THREADED RODS MAY NEED TO BE TRIMMED.

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ELKAY®
SPECIFICATIONS

Elkay ezH2O In-Wall Bottle Filling Station with Mounting Frame Filtered Non-Refrigerated Stainless
Model LZWSMDK

PRODUCT SPECIFICATIONS

Elkay ezH2O® In-Wall Bottle Filling Station with Mounting Frame, Filtered Non-Refrigerated Stainless. Features shall include Antimicrobial, Filtered, Green Ticker™, Hands Free, Laminar Flow, Real Drain, Visual Filter Monitor. Electronic Bottle Filler Sensor activation. Product shall be Wall Mount (Inwall Frame/Plate), for Indoor applications, serving 1 station(s). Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120. Unit shall be lead-free design which is certified to NSF/ANSI 61 & 372 (lead free) and meets Federal and State low-lead requirements.

BF-1
(or equal product)

Special Features:	Antimicrobial, Filtered, Green Ticker™, Hands Free, Laminar Flow, Real Drain, Visual Filter Monitor
Finish:	Stainless Steel
Power:	115V/60Hz
Bubbler Style:	No Bubbler
Activation by:	Electronic Bottle Filler Sensor
Mounting Type:	Wall Mount (Inwall Frame/Plate)
Chilling Capacity:	Non-refrigerated
Full Load Amps	1
Rated Watts:	15
Dimensions (L x W x H):	19-3/4" x 3-1/2" x 40-13/16"
Approx. Shipping Weight:	36 lbs.
Installation Location:	Indoor
No. of Stations Served:	1

Special Note: Refrigerated options available.

- Visual Filter Monitor: LED Filter Status Indicator for when filter change is necessary.
- Filter is certified to NSF 42 and 53 for lead, particulate, chlorine, taste and odor reduction. 3,000 gal. capacity.
- Green Ticker: Informs user of number of 20 oz. plastic water bottles saved from waste.
- Laminar flow provides clean fill with minimal splash.
- Silver Ion Antimicrobial protection on key plastic components to inhibit the growth of mold and mildew.
- Real Drain System eliminates standing water.

Included with Product: **Bottle Filler (LZWSMDC), Mounting Frame (MFWS100), Filter (EWF3000)**

▼ Ships in multiple boxes.

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PRODUCT COMPLIANCE

ADA & ICC A117.1
Buy American Act
CAN/CSA C22.2 No. 120
GreenSpec®
NSF/ANSI 42, 53, 61, & 372 (lead free)
UL 399

Complies with ADA & ICC A117.1 accessibility requirements when installed according to the requirements outlined in these standards. Installation may require additional components and/or construction features to be fully compliant. Consult the local Authority Having Jurisdiction if necessary.

Installation Instructions (PDF) - 98560C
Installation Instructions (PDF) - 98557C

Electrical components and water system are warranted for 12 months from date of installation. **Warranty pertains to drinking water applications only. Non-drinking water applications are not covered under warranty.**

Warranty (PDF)

PART:_____QTY: _____
PROJECT:_____
CONTACT:_____
DATE:_____
NOTES:_____
APPROVAL:_____

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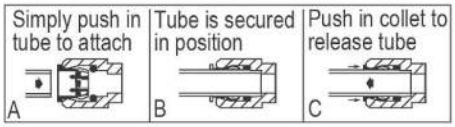
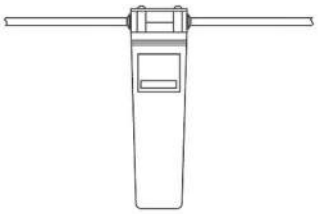
BF-1
(or equal product)

OPERATION OF QUICK CONNECT FITTINGS



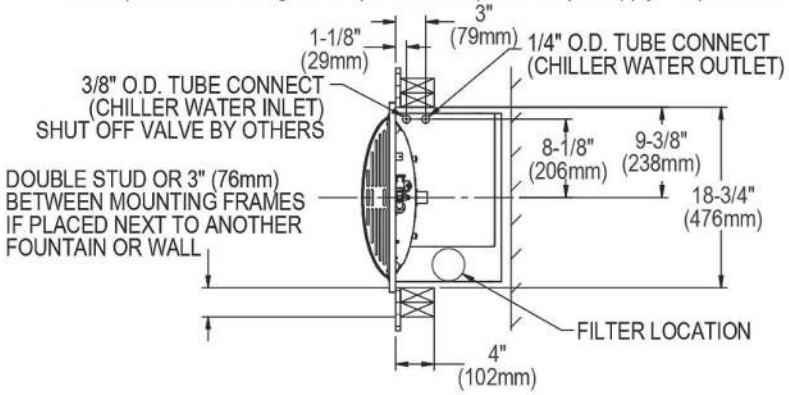
Pushing tube in before pulling it out helps to release tube



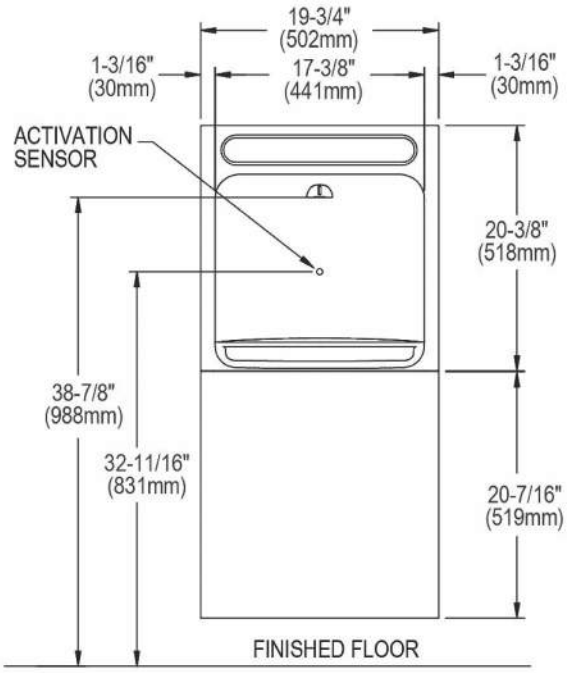
WaterSentry® Plus Filter System

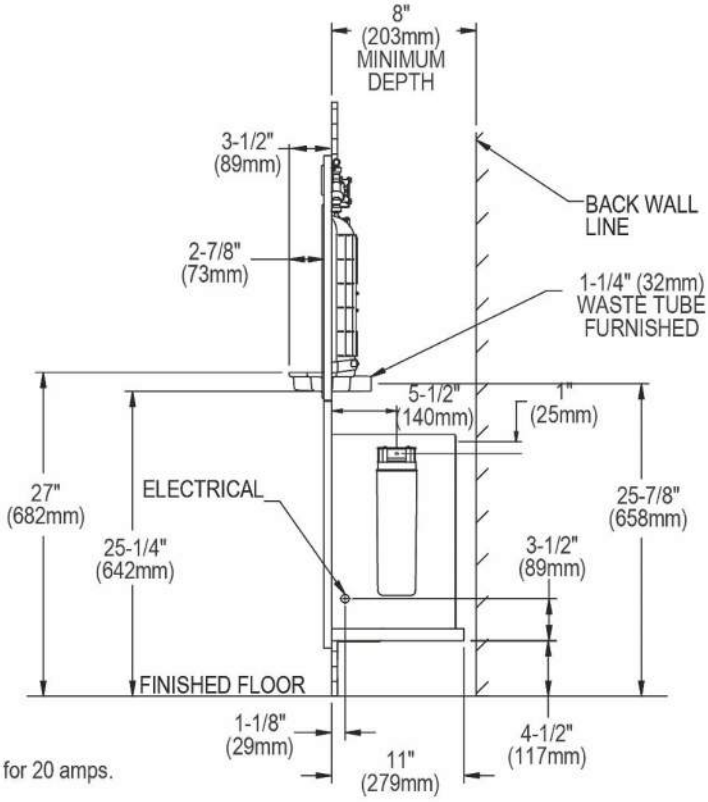
IMPORTANT!
INSTALLER PLEASE NOTE:

The grounding of electrical equipment such as telephone, computers, etc., to water lines is a common procedure. This grounding may be in the building or may occur away from the building. This grounding can cause electrical feedback into a water cooler, creating an electrolysis which causes a metallic taste or causes an increase in the metal content of the water. This condition is avoidable by using the proper materials as indicated below. The drain fittings which are provided by the installer should also be plastic to electrically isolate the cooler from the building plumbing system
These products are designed to operate on 20 psi to 105 psi supply line pressure.



BOTTLE FILLER SPECIFICATIONS





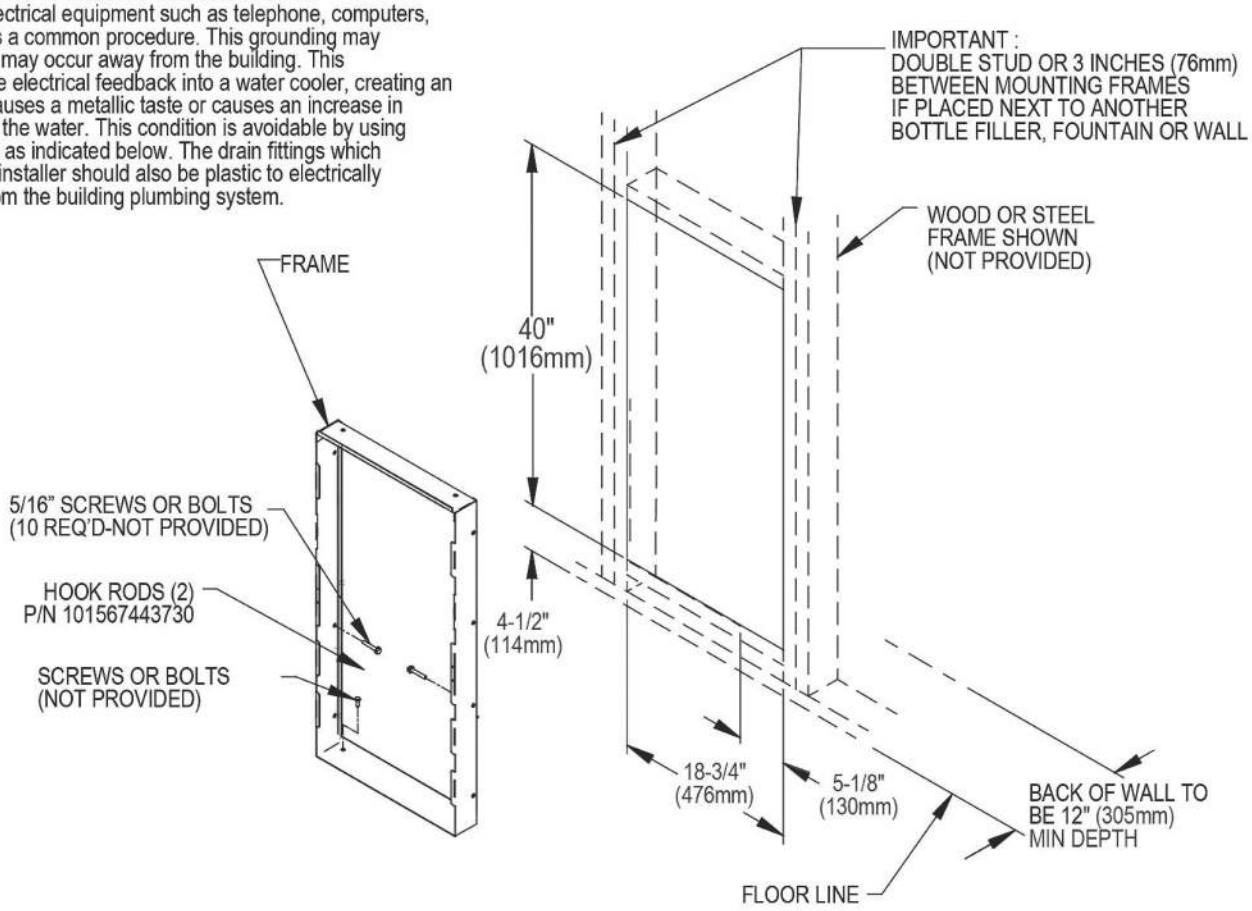
Note : New Installations Must Use Ground Fault Circuit Interrupter (GFCI).
It is highly recommended that the circuit be dedicated and the load protection be sized for 20 amps.

In keeping with our policy of continuing product improvement, Elkay reserves the right to change product specifications without notice. Please visit elkay.com for the most current version of Elkay product specification sheets. This specification describes an Elkay product with design, quality, and functional benefits to the user. When making a comparison of other producers' offerings, be certain these features are not overlooked.

BF-1
(or equal product)

MOUNTING FRAME MFWS100 WITHOUT CHILLER SHELF

IMPORTANT!
INSTALLER PLEASE NOTE:
The grounding of electrical equipment such as telephone, computers, etc., to water lines is a common procedure. This grounding may be in the building or may occur away from the building. This grounding can cause electrical feedback into a water cooler, creating an electrolysis which causes a metallic taste or causes an increase in the metal content of the water. This condition is avoidable by using the proper materials as indicated below. The drain fittings which are provided by the installer should also be plastic to electrically isolate the cooler from the building plumbing system.



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Florestone
Models 80 / 81 / 82 / 83
Terrazzo Mop Receptors

JS-1
(or equal product)

Architect's Specifications

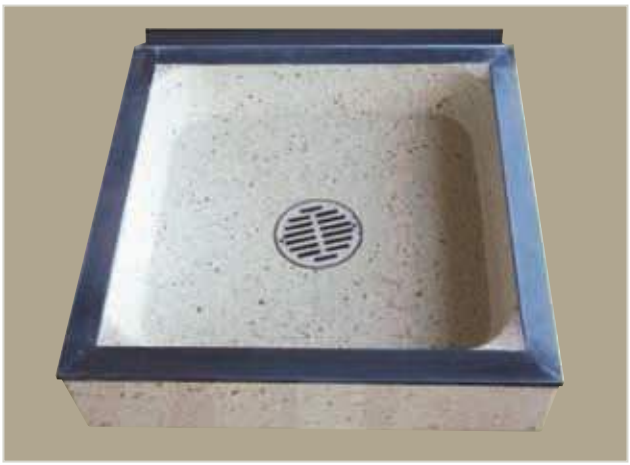
Furnish and install mop receptor as manufactured by Florestone Products Co. Shoulder shall be not less than 4" high inside and not less than 1¾" wide. (For high wall model specify: "Not less than 9" high inside and not less than 1¾" wide"). Galvanized, bonderized steel flange will extend at least one inch above shoulder on one, two or three sides for installation against stud wall (specify choice). Stainless steel protective cap to be cast integral on all four exposed sides. Drain body shall be brass, cast integral and shall provide for a non-caulked connection (lead caulked optional) not less than one inch deep to a two or three inch pipe (specify 2" or 3"). Mop sinks with 3" drains are supplied with a rubber seal for use on ABS, PVC or steel pipe. Receptor shall be manufactured of tan and white marble chips cast in white portland cement to produce a compressive strength of not less than 3000 PSI, seven days after casting. Terrazzo surface shall be ground and polished with all air holes and/or pits to be grouted and excess removed and sealed to resist stains and moisture. Receptor will be reinforced with 16 gauge wire.

Note: Terrazzo is not designed to be used with anything that is over 130 degrees Fahrenheit.

Note:
Specify 6" or 12" height.
Specify 2" or 3" drain size (3" standard).
Specify Model Number and size.
Specify Right Hand or Left Hand where applicable.

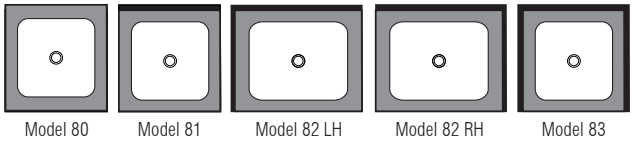
FLORESTONE
A Spec Above.™

FLORESTONE PRODUCTS CO., INC.
2851 Falcon Drive • Madera, CA 93637
T. 559.661.4171 • T. 800.446.8827
F. 559.661.2070 • florestone.com

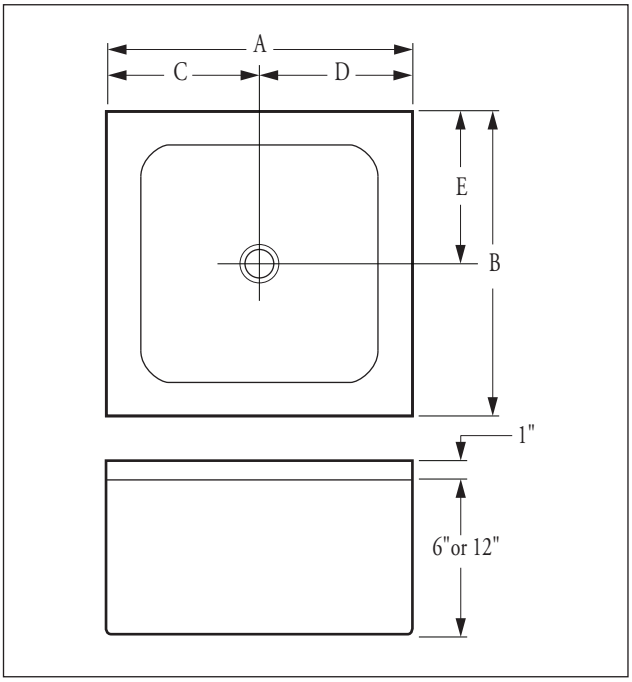


Shown: Model 81

Flanges: Stainless Steel Caps:



Model 80 | Model 81 | Model 82 LH | Model 82 RH | Model 83



Dimensions may vary ± ¼". Please check unit before installation.

A	B	HT.	C	D	E	WT.
24"	24"	6"	12"	12"	12"	225
32"	32"	6"	16"	16"	16"	320
36"	24"	6"	18"	18"	12"	295
36"	36"	6"	18"	18"	18"	385
24"	24"	12"	12"	12"	12"	355
32"	32"	12"	16"	16"	16"	488
36"	24"	12"	18"	18"	12"	430
36"	36"	12"	18"	18"	18"	525

SC-5811

SPEAKMAN®

Commander® Utility Sink Faucet

JS-1
(or equal product)

MODELS:

- SC-5811: Polished chrome plated utility sink
- SC-5811-RCP: Rough polished chrome plated utiltiy sink

FEATURES:

- Chrome plated cast brass construction
- Cast brass nozzle with 3/4" hose thread and pail hook
- Integral stops allow water shut off for servicing
- Brass vacuum breaker to prevent backflow
- 1/4 turn ceramic cartridges to ensure drip-free performance
- Vandal-resistant cross handles with color-coded indexes
- 9" from finished wall to nozzle outlet
- 8" fixed centers with adjustable threaded brass wall flanges allows 1/4" +/- adjustments
- 1/2" -14 NPT female inlets (supply lines not included)
- Brass top brace assembly with wall flange and mounting screws

HANDLE/HOSE ADD-ONS:

- A-4WRIST: 4" wrist blade handle kit
- A-5H: 5' vinyl hose with wall hook

SAFETY ADD-ONS:

- SEF-9200: Eyesaver® Drench Hose Attachment

FAUCET ADD-ONS:

- A-CK: Check valves in swivel assembly

STANDARDS:

- ASME A112.18.1/CSA B125.1 certified
- ASSE 1001 certified

WARRANTY:

Visit www.speakman.com for full product warranty information

- 5 Year Limited Warranty (commercial)
- 5 Year Limited Warranty (residential)

Information continues on next page

1. All dimensions are in inches (millimeters) unless otherwise specified and are subject to change without notice. 2. Inlets are 1/2" NPT female.

Architect/Engineer Approval Space:

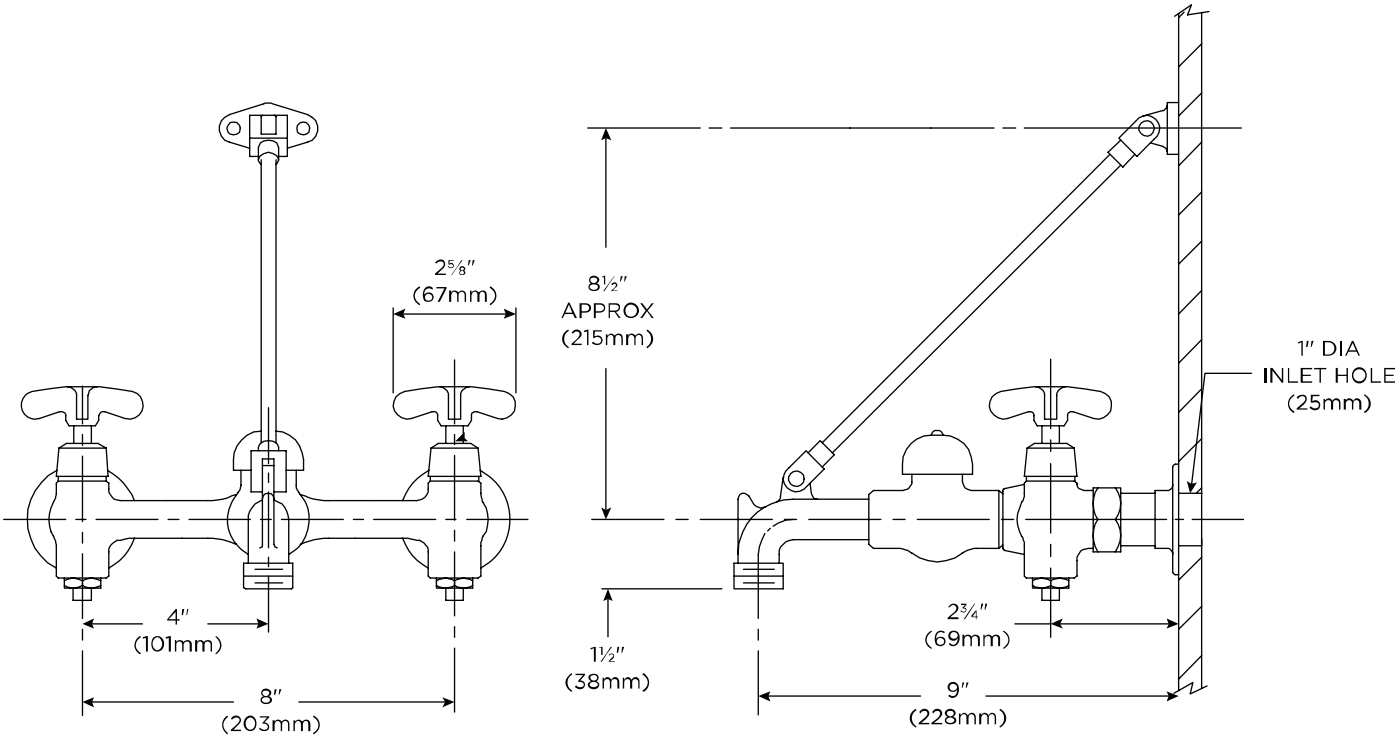
P: 800-537-2107
F: 800-977-2747
W: WWW.SPEAKMAN.COM
R: 02-NOVEMBER 2019

SC-5811

SPEAKMAN®

Commander® Utility Sink Faucet

JS-1
(or equal product)



1. All dimensions are in inches (millimeters) unless otherwise specified and are subject to change without notice.

Architect/Engineer Approval Space:

P: 800-537-2107
F: 800-977-2747
W: WWW.SPEAKMAN.COM

R: 02-NOVEMBER 2019

American Standard
Style That Works Better

JS-2
(or equal product)

LAKEWELL™ SERVICE SINK
ENAMELED CAST IRON

LAKEWELL™ SERVICE SINK

- Enameled cast iron (inside only enameled)
- Supplied with wall hanger and rim guard
- Available with plain back or drilled back for faucet

☑ **7692.008** With drilled back 2 holes on 8" centers and rim guard

❑ **7692.000** With plain back and rim guard (no faucet hole drilling)

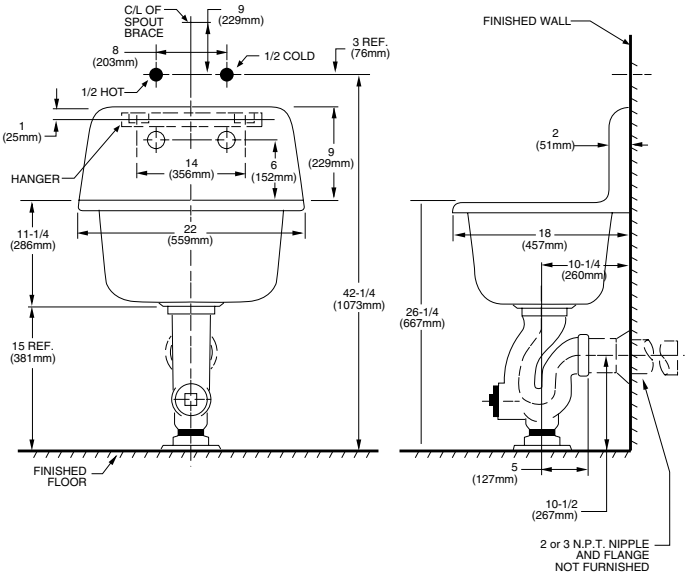
Available Components:

❑ **8379.018** Rim Guard

Nominal Dimensions:
559 x 457mm
(22" x 18")

Bowl sizes:
18-1/2" (470mm) wide
14-1/8" (359mm) front to back
10-1/2" (267mm) deep

Compliance Certifications -
Meets or Exceeds the Following Specifications:
• ASME A112.19.1 for Cast Iron Plumbing Fixtures



To Be Specified:
- ❑ Faucet: 8340.235 exposed yoke wall-mount utility faucet
- ❑ Faucet: 8340.243 same as above with vacuum breaker
- ❑ Faucet: 8341.076 same as above with vacuum breaker and stops in shank
- ❑ Alternative Faucet
- ❑ Trap Standard: 7798.030 cast iron "P" trap standard to wall and strainer for 3" iron pipe
- ☑ Trap Standard: 7798.020 cast Iron "P" trap standard to wall and strainer for 2" iron pip

NOTES:
PROVIDE SUITABLE REINFORCEMENT FOR ALL WALL SUPPORTS. FITTING AND TRAP STANDARD NOT INCLUDED AND MUST BE ORDERED SEPARATELY.

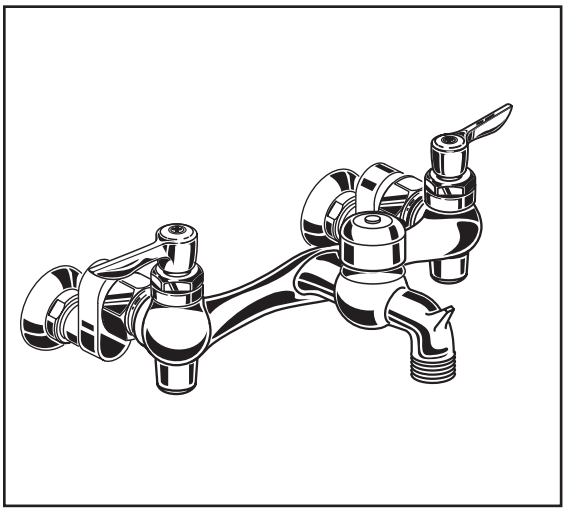
IMPORTANT: Dimensions of fixtures are nominal and may vary within the range of tolerances established by ANSI Standard A112.19.2. These measurements are subject to change or cancellation. No responsibility is assumed for use of superseded or voided pages.

American Standard
Style That Works Better

JS-2
(or equal product)

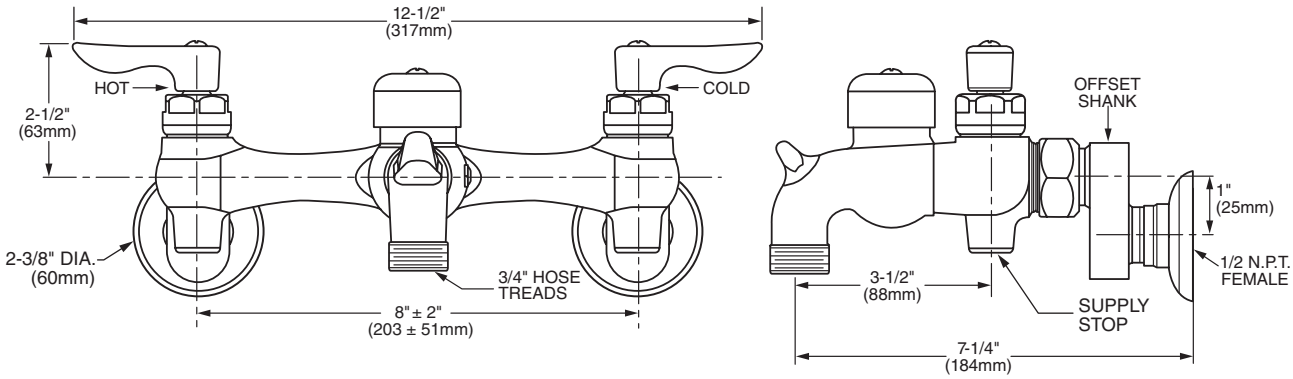
EXPOSED YOKE WALL-MOUNT UTILITY FAUCET

WITH VACUUM BREAKER AND OFFSET SHANKS



MODEL NUMBER:

☑ **8351.076 Exposed Yoke Wall-Mount Utility Faucet**
3" Cast brass spout with vacuum breaker. Ceramic disc valves. Integral supply stops. Offset shanks with integral check valves. Vandal-resistant metal lever handles. Bucket hook. 3/4" Threaded hose end. 1/2" NPT female inlets. Adjustable centers-to-centers: 6" - 10" (152mm - 254mm).



GENERAL DESCRIPTION:

Cast brass body. Metal lever handles with hot and cold indicators and vandal-resistant screws. 1/4 turn ceramic disc valve cartridges. Vacuum breaker prevents back flow. Integral supply stops. Offset shanks with integral check valves to prevent cross-flow. Spout with bucket hook and threaded hose end. 1/2" female inlets with adjustable centers from 6" to 10" (152mm to 254mm).

PRODUCT FEATURES:

Cast Brass Construction: Durable - Excellent in high use applications.

Ceramic Disc Valve Cartridges: Assure a lifetime of drip-free performance.

Integral Supply Stops: Permits easy and convenient access.

Offset Shanks with Integral Check Valves: Adjustable rough-in from 6" to 10" (152mm to 254mm).

Vacuum Breaker: Prevents back flow.

Choice of Finishes: Available in Polished Chrome (002) or Rough Chrome (004).

SUGGESTED SPECIFICATION

Exposed yoke wall-mount utility faucet shall feature a cast brass body with integral stops. Cast brass spout with bucket hook and vandal-resistant metal lever handles. Offset shanks with integral check valves to prevent cross-flow, provide adjustable rough-in from 6" - 10" (152mm to 254mm). Shall feature a vacuum breaker to prevent back flow. Shall also feature 1/4 turn washerless ceramic disc valve cartridges. Fitting shall be American Standard Model # 8351.076.___.

American Standard
Style That Works Better

JS-2
(or equal product)

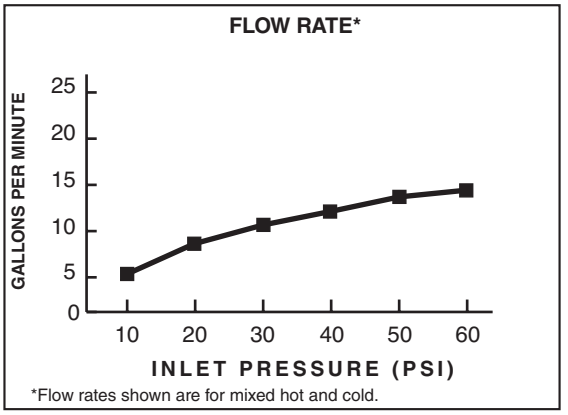
EXPOSED YOKE WALL-MOUNT UTILITY FAUCET

WITH VACUUM BREAKER AND OFFSET SHANKS

CODES AND STANDARDS

These products meet or exceed the following codes and standards:

ASME A112.18.1
CSA B 125
ANSI A117.1



Product Number	Description	Finish Options	
		Polished Chrome 002	Rough Chrome 004
8351.076	Exposed yoke wall-mount utility faucet. Ceramic disc valves. Integral supply stops. Offset shanks with integral check valves. Vandal-resistant lever handles.	✔	

MEETS THE AMERICANS WITH DISABILITIES ACT GUIDELINES AND ANSI A117.1 REQUIREMENTS FOR ACCESSIBLE AND USABLE BUILDING FACILITIES-CHECK LOCAL CODES

ELKAY®
SPECIFICATIONS

SINKS
(or equal product)

Elkay Lustertone Classic Stainless Steel 25" x 22" x 5-1/2" Single Bowl Drop-in ADA Sink
Model(s) LRADQ252255

PRODUCT SPECIFICATIONS

Elkay Lustertone™ Classic Stainless Steel 25" x 22" x 5-1/2", Single Bowl Drop-in ADA Sink. Sink is manufactured from 18 gauge 304 Stainless Steel with a Lustrous Satin finish, Rear Center drain placement, and Bottom only pads.

Installation Type:	Drop-in
Material:	304 Stainless Steel
Special Features:	Quick-Clip Mounting System
Finish:	Lustrous Satin
Gauge:	18
Sound Deadening:	Bottom only pads
Number of Bowls:	1
Sink Dimensions:	25" x 22" x 5-1/2"
Bowl 1 Dimensions:	21" x 15-3/4" x 5-1/8"
Drain Size:	3-1/2" (89mm)
Drain Location:	Rear Center
Minimum Cabinet Size:	30"
Mounting Hardware:	Included for 3/4" (19mm) countertop
Template Included:	No
Cutout Template #:	1000001188

Template is available for download at elkay.com. CAD software will be required to open the template.

Cutout Dimensions for Drop-in Installation:
24-3/8" x 21-3/8" (619mm x 543mm) with 1-1/2" (38mm) corner radius

Custom Options	
□ Type 316 Stainless Steel	
Drain Location	
□ Right Rear	□ Left Rear
□ Center	□ Center Rear
Overflow Location	
□ Front	□ Rear
Alternate Punching	
□ Faucet Model:	□ Punch Required:
Sink Size	
□ Bowl Depth:	□ Drainboard Width:

AMERICAN PRIDE. A LIFETIME TRADITION.
Like your family, the Elkay family has values and traditions that endure. For almost a century, Elkay has been a family-owned and operated company, providing thousands of jobs that support our families and communities.

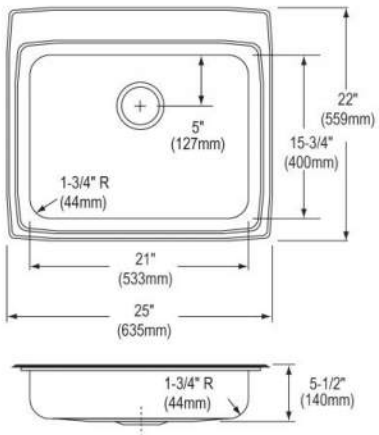
Product Compliance: ADA & ICC A117.1
ASME A112.19.3/CSA B45.4
Buy American Act

Sinks are listed by IAPMO® as meeting the applicable requirements of the Uniform Plumbing Code®, International Plumbing Code®, and National Plumbing Code of Canada.

Complies with ADA & ICC A117.1 accessibility requirements when installed according to the requirements outlined in these standards.

Clean and Care Manual (PDF)
Installation Instructions (PDF)
Warranty (PDF)

Similar models are available with: U Channel mounting system, additional ADA depths



PART:_____QTY: _____
PROJECT:_____
CONTACT:_____
DATE:_____
NOTES:_____
APPROVAL:_____

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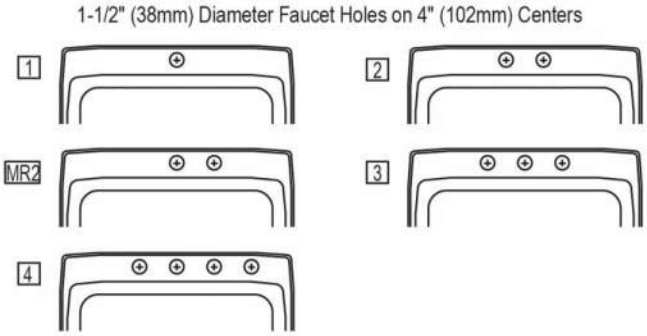
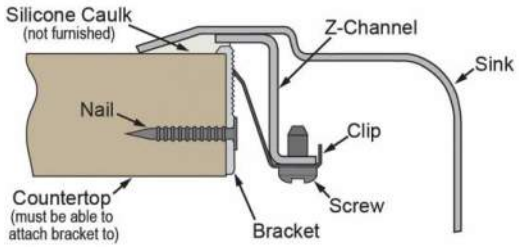
Hole Drilling Configurations:



Installation Profile:



Optional Accessories		
LKWOBG2115SS	Elkay Stainless Steel 20" x 14-3/4" x 1" Bottom Grid Spec Sheet (PDF)	
CB1516	Elkay Hardwood 15" x 16-3/4" x 3/4" Cutting Board Spec Sheet (PDF)	
LK99	Elkay Deluxe 3-1/2" Drain Type 304 Stainless Steel Body Strainer Basket Rubber Seal and Tailpiece Spec Sheet (PDF)	
LKAD35	Elkay 3-1/2" Drain Fitting" Stainless Steel Body Strainer Basket and Offset Tailpiece Spec Sheet (PDF)	
LKWERBSS	Elkay Stainless Steel 15-3/8" x 12-3/8" x 5-7/16" Rinsing Basket Spec Sheet (PDF)	

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KOHLER Faucets

SINKS
(or equal product)

Forté®
Kitchen Sink Faucet
K-10415

Features
- KOHLER ceramic disc valves exceed industry longevity standards for a lifetime of durable performance.
- Single lever handle is simple to use and makes adjusting water temperature easy.
- Temperature memory allows faucet to be turned on and off at the temperature set during prior usage.
- 1.5 gpm (5.7 lpm) maximum flow rate at 60 psi (4.14 bar).

Material
- Premium metal construction for durability and reliability.
- KOHLER finishes resist corrosion and tarnishing.

Installation
- For single-hole installation.
- Flexible supply lines simplify installation.

Recommended Products/Accessories
K-1893-C Soap/Lotion Dispenser
K-1894-C Soap/lotion dispenser
K-1895-C Soap/Lotion Dispenser
K-23723 Faucet cleaner

ADA | **CSA B651**

Codes/Standards
ASME A112.18.1/CSA B125.1
NSF/ANSI 61
NSF/ANSI 372
All applicable US Federal and State material regulations
DOE - Energy Policy Act 1992
California Energy Commission (CEC)
ADA
ICC/ANSI A117.1
CSA B651

KOHLER® Faucet Lifetime Limited Warranty
See website for detailed warranty information.

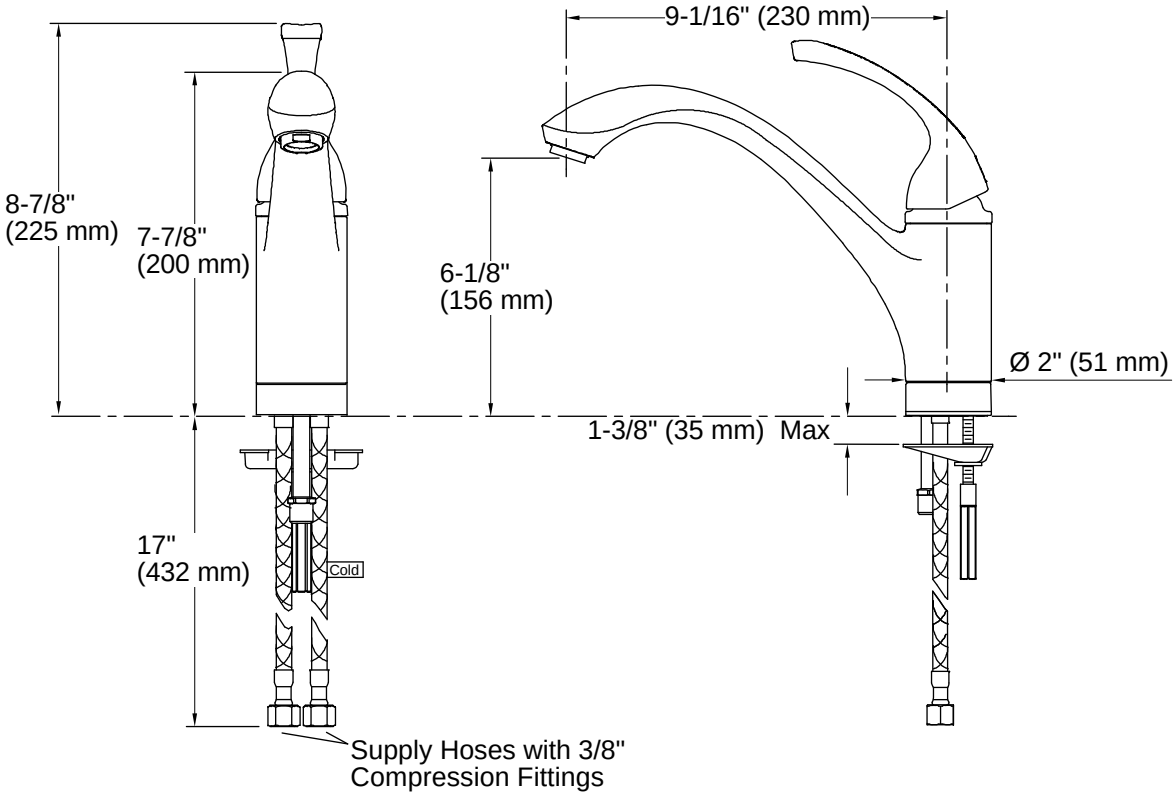
Available Colors/Finishes
Color tiles intended for reference only.

Color	Code	Description
	CP	Polished Chrome
	BN	Vibrant® Brushed Nickel
	VS	Vibrant® Stainless

KOHLER. Faucets

SINKS
(or equal product)

Forté®
Kitchen Sink Faucet
K-10415



Technical Information
All product dimensions are nominal.

Spout:
Spout reach: 9-1/16" (230 mm)

Notes
Install this product according to the installation guide.

ADA, CSA B651 compliant when installed to the specific requirements of these regulations.

ADVANCE TABCO®
SMART FABRICATION™

S-3
ART STUDIO SINK
(or equal product)

STAINLESS STEEL

REGALINE SINKS

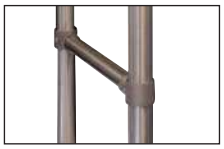
One Compartment - One Drainboard

(Specify Drainboard Location)

Item #: _____ Qty #: _____
Model #: _____
Project #: _____

93 & 9 SERIES
Adjustable Side
Cross-Bracing

94 SERIES
Adjustable Side &
Front Cross-Bracing



93 & 9 Series Adjustable
Side Cross-Bracing

94 Series Adjustable
Side & Front Cross-Bracing

Recessed Bowl Surface
Accommodates Poly-Vance
Cutting Boards & Sink Covers

YES! It's SeaMLess!

FEATURES:

Tile edge for ease of installation.

One piece **Deep Drawn** sink bowls with integral drainboards with splash.

Featuring the single bowl unit design.

All sink bowls have a large liberal 3" radius.

"94" Series is supplied with adjustable front and side cross braces featuring leg clamps to secure left to right cross bracing.

"93" & "9" Series is supplied with adjustable side cross braces featuring leg clamps to secure left to right cross bracing.

CONSTRUCTION:

All TIG welded.

Welded areas blended to match adjacent surfaces and to a satin finish.

MATERIALS:

Spec-Line (94 Series): 14 gauge type 304 stainless steel
11" High Splash.

Standard (93 Series): 16 gauge type 304 stainless steel
8" High Splash.

Super Saver (9 Series): 18 gauge type 304 stainless steel
8" High Splash.

LEGS:
- 1 5/8" diameter tubular stainless steel.
- Stainless steel gussets.
- Stainless Steel 1" adjustable bullet feet.

Bowl Size	O.A. Length	DRBD. Size	SPEC-LINE 94 Series Model #	WT.	STANDARD 93 Series Model #	WT.	SUPER SAVER 9 Series Model #	WT.	Cu. Ft.
			14 Ga. 304 S/S 14" Water Level		**16 Ga. 304 S/S** 12" Water Level		**18 Ga. 304 S/S** 12" Water Level		
16" x 20"	40"	18"	94-1-24-18R or L	93 lbs.	93-1-24-18R or L	75 lbs.	9-1-24-18R or L	65 lbs.	20
	46"	24"	94-1-24-24R or L	98 lbs.	93-1-24-24R or L	80 lbs.	9-1-24-24R or L	73 lbs.	24
	58"	36"*	94-1-24-36R or L	114 lbs.	93-1-24-36R or L	90 lbs.	9-1-24-36R or L	78 lbs.	26
20" x 20"	44"	18"	94-21-20-18R or L	98 lbs.	93-21-20-18R or L	80 lbs.	9-21-20-18R or L	71 lbs.	20
	50"	24"	94-21-20-24R or L	104 lbs.	93-21-20-24R or L	86 lbs.	9-21-20-24R or L	77 lbs.	27
	62"	36"*	94-21-20-36R or L	127 lbs.	93-21-20-36R or L	107 lbs.	9-21-20-36R or L	91 lbs.	31
18" x 24"	42"	18"	94-61-18-18R or L	100 lbs.	93-61-18-18R or L	84 lbs.	9-61-18-18R or L	75 lbs.	24
	48"	24"	94-61-18-24R or L	106 lbs.	93-61-18-24R or L	92 lbs.	9-61-18-24R or L	84 lbs.	27
	60"	36"*	94-61-18-36R or L	130 lbs.	93-61-18-36R or L	109 lbs.	9-61-18-36R or L	95 lbs.	38
24" x 24"	54"	24"	94-41-24-24R or L	126 lbs.	93-41-24-24R or L	105 lbs.	9-41-24-24R or L	92 lbs.	28
	66"	36"*	94-41-24-36R or L	149 lbs.	93-41-24-36R or L	126 lbs.	9-41-24-36R or L	110 lbs.	42
20" x 28"	44"	18"	94-81-20-18R or L	139 lbs.	93-81-20-18R or L	116 lbs.	9-81-20-18R or L	107 lbs.	36
	50"	24"	94-81-20-24R or L	146 lbs.	93-81-20-24R or L	122 lbs.	9-81-20-24R or L	113 lbs.	46
	62"	36"*	94-81-20-36R or L	170 lbs.	93-81-20-36R or L	142 lbs.	9-81-20-36R or L	133 lbs.	54
			14" Water Level 18" Flood Level		12" Water Level 16" Flood Level		12" Water Level 16" Flood Level		

*** Regalines with 36" Drainboards are Supplied with Two Additional Legs for Support.**

Weights & Cubes Are Approximate

ADVANCE TABCO®
SMART FABRICATION™
www.advancetabco.com

Customer Service Available To Assist You 1-800-645-3166 8:30 am - 7:00 pm E.S.T.

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Email: customer@advancetabco.com or **Fax:** 631-242-6900

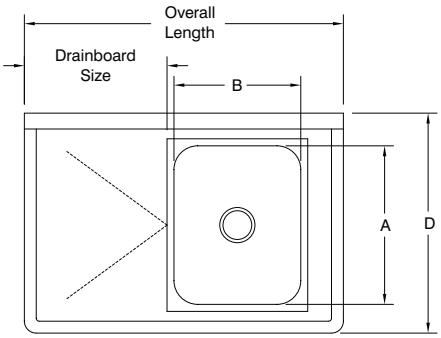
For Smart Fabrication™ Quotes:
Email: smartfab@advancetabco.com or **Fax:** 631-586-2933

DIMENSIONS and SPECIFICATIONS

TOL Overall: ± .500”
Interior: ± .250”

ALL DIMENSIONS ARE TYPICAL

(SPECIFY DRAINBOARD LOCATION)



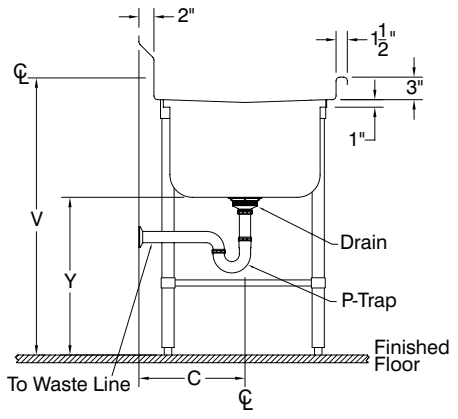
(Left hand Drainboard Shown)

S-3
ART STUDIO SINK
(or equal product)

DESCRIPTION								94 SERIES					9 & 93 SERIES				
BOWL SIZE	Overall Length	DRBD SIZE	Recommended Use	A	B	C	D	V	W	X	Y	Z	V	W	X	Y	Z
16”x20”	40” 46” 58”	18” 24” *36”	DISH SINKS	20”	16”	14 1/8”	28”	38”	11”	14”	19”	45”	38”	8”	12”	21”	42”
20”x20”	44” 50” 62”	18” 24” *36”	DISH & POT SINKS	20”	20”	14 1/8”	28”	38”	11”	14”	19”	45”	38”	8”	12”	21”	42”
18”x24”	42” 48” 60”	18” 24” *36”	POT & PAN SINKS	24”	18”	16 1/8”	32”	38”	11”	14”	19”	45”	38”	8”	12”	21”	42”
24”x24”	54” 66”	24” *36”	POT SINKS	24”	24”	16 1/8”	32”	38”	11”	14”	19”	45”	38”	8”	12”	21”	42”
20”x28”	44” 50” 62”	18” 24” *36”	PAN SINKS	28”	20”	16 1/8”	36”	38”	11”	14”	19”	45”	38”	8”	12”	21”	42”

*** Regalines with 36” Drainboards are Supplied with Two Additional Legs for Support.**

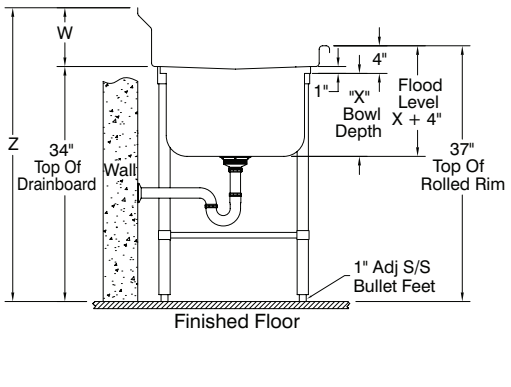
PLUMBING ROUGH-IN



MECHANICAL:

- Supply is 1/2” IPS hot & cold.
- Faucet holes on 8” centers.
- Faucets are not included **(see accessories)**.
- Waste drains are 1 1/2” IPS S/S basket type, located in center of sink bowl, and are included.

SECTION



ADVANCE TABCO
SMART FABRICATION™

ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.

325 Wireless Boulevard, Hauppauge, NY 11788

ADVANCE TABCO
SMART FABRICATION™

14 GAUGE STAINLESS STEEL

ONE STATION A.D.A. WALL MOUNTED SINK WITH TUBULAR SUPPORTS

WITH/WITHOUT MANUAL FAUCETS

Manual Operated Shown
(Faucet Not Included)

"-F" Series Sink Includes
K-161-LU Gooseneck Faucets
with Wrist Handles

S-4
ADA ART STUDIO SINK
(or equal product)

14 Gauge

A.D.A. COMPLIANT

NSF

FEATURES:

8 1/2" high backsplash.

5" sink bowl depth.

Two stainless steel "Z" brackets supplied each unit.

One **K-6** 3 1/2" rear basket drain.

Two tubular stainless steel support brackets that allow full clearance underneath.

Manual Operated: Faucets sold separately.

"-F" Series includes one **K-161-LU** 6" gooseneck faucet with wrist handles.

CONSTRUCTION:

All TIG welded.

Welded areas blended to match adjacent surfaces and to a satin finish.

Die formed tubular wall brackets.

MATERIAL:

All 14 gauge type "304" stainless steel.

1 5/8" tubular "304" stainless steel wall brackets.

Stainless steel gussets.

MECHANICAL:

8" O.C. faucet holes punched.

Model #	Length	# of Faucets Sink Accommodates	# of Faucets Included	Wt.	Cu. Ft.
FS-WM-1-ADA	40"	1	0 (Faucets Not Included)	77 lbs.	15
FS-WM-1-ADA-F	40"	1	1 (K-161-LU Faucets Included)	77 lbs.	15

Click Here For Install Guide

MULTI-STATION ACCESSORIES & REPLACEMENT PARTS

	Model	Description	QTY:
	K-6	3 1/2" Drain (1 1/2" I.P.S.)	_____
📦	K-13	Stainless Steel Soap Dispenser (Wall Mount Only)	_____
📦	K-06	Splash Mount Faucet Mounting Kit	_____
📦	K-101	8" Swing Spout Splash Mt. Faucet	_____
📦	K-159	Splash Mounted 3-1/2" Gooseneck Faucet *(8" O.C.)*	_____
📦	K-160	Splash Mounted 6" Swivel Spout Faucet *(8" O.C.)*	_____
📦	K-411	Strainer Plate for 3-1/2" Drain	_____
📦	K-1118	Extra H.D. 8" Splash Mounted Faucet	_____
📦	K-316-LU	Wrist Handles	_____
	K-472	Faucet Hole Revision *(Manual Faucet Operated Sinks Only)*	_____
	K-449	5" Backsplash Modification (Used When Installing A Mirror Over An Ada Multi-Station Or Service Sink) Mirror Supplied By Others	_____
	K-508	Special Sizing Charge *(Larger Size Cut Down To Smaller Size)*	_____
📦	TA-19	Adjustable Stainless Steel Flanged Bullet Foot	_____

K-159

K-160

K-161-LU

K-13

K-06

📦 = Ships UPS

Standard Faucets conform to NSF 61 Standard 9 and compliance to AB 1953 Standards.

⚠ **WARNING:** Equipment that include faucets on this page may contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

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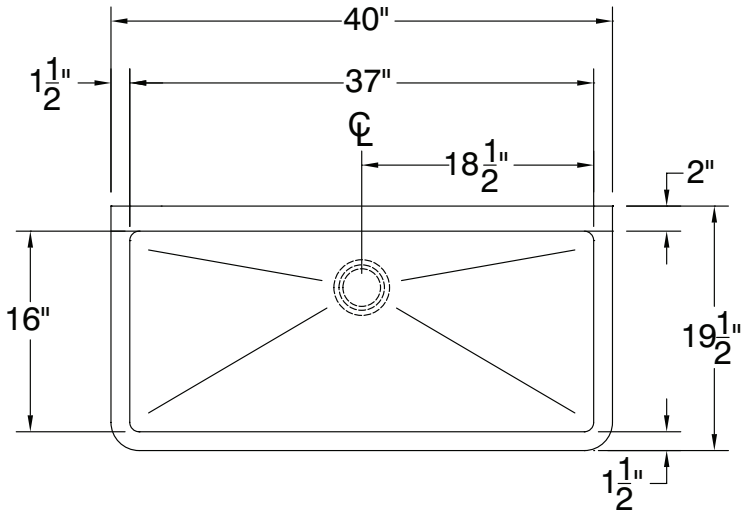
For Smart Fabrication™ Quotes:
Email: smartfab@advancetabco.com or Fax: 631-586-2933

DETAILS and SPECIFICATIONS

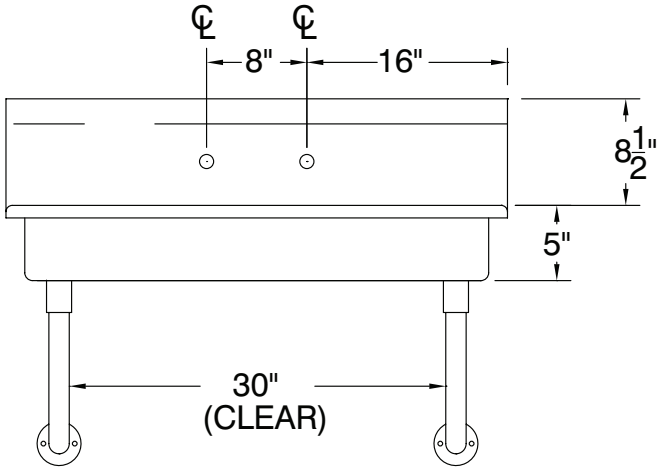
TOL ± .500” | FITTINGS SUPPLIED AS SHOWN | ALL DIMENSIONS ARE TYPICAL

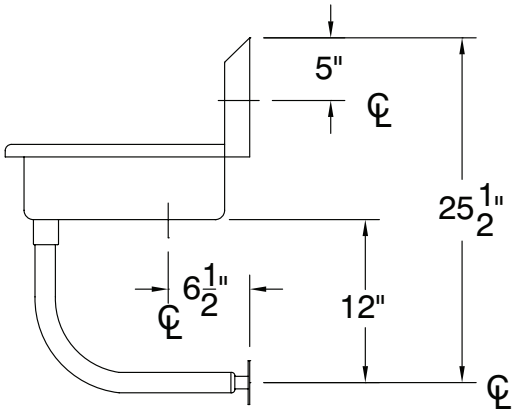
FS-WM-1-ADA

S-4
ADA ART STUDIO SINK
(or equal product)



A.D.A.
COMPLIANT





77 Lbs.

DOOR HARDWARE CUTSHEETS

Catalog Cuts

For

2118 Milvia St Building

Sorted By Manufacturer

Prepared By

Michelle Bond

Created On 5/2/2022

Generated By

Table of Contents

Mfr	Catalog Number	Description
ACC	2001BSTK	BARN DOOR STRIKE
ACC	SL9145ADA	CLASSROOM LOCK CASE
BLU	PA-100-F W/ KEY LOCK	EXIT DEVICE
C-R	CL3357 PZD, CYLINDER PER PG&E	STOREROOM/CLOSET LOCK
DRM	RTS88	OVERHEAD CONC. CLOSER
GLY	90S	OH STOP
GLY	100H	OH STOP & HOLDER
GLY	100S	OH STOP
IVE	FB31P	AUTO FLUSH BOLT
IVE	FB51P	CONST LATCHING BOLT
IVE	FB458 12"	MANUAL FLUSH BOLT
IVE	FB458 24"	MANUAL FLUSH BOLT
IVE	COR X FL	COORDINATOR
IVE	MB	MOUNTING BRACKET
IVE	7215 BTM	BOTTOM PIVOT
IVE	91105F	POCKET PIVOT
IVE	FS18S	FLOOR STOP
IVE	WS401/402CCV	WALL STOP
IVE	WS40	WALL STOP/HOLDER
IVE	SR64	SILENCER
IVE	8400 10" X 2" LDW B-CS	KICK PLATE
IVE	5BB1 4.5 X 4.5	HINGE
IVE	5BB1 4.5 X 4.5 TW8	ELECTRIC HINGE
IVE	5BB1HW 4.5 X 4.5	HINGE
IVE	5BB1HW 5 X 4.5	HINGE
IVE	5BB1HW 5 X 4.5 NRP	HINGE
IVE	5BB1HW 4.5 X 4.5 TW8	ELECTRIC HINGE
IVE	5BB1HW 5 X 4.5 TW8	ELECTRIC HINGE
IVE	700	CONT. HINGE
IVE	700 EPT	CONT. HINGE
IVE	9264 36" 20" O	LONG DOOR PULL
IVE	FS439 OR WS401/402CVX	DOOR STOP
IVE	224XY	CONT. HINGE
IVE	224XY EPT	CONT. HINGE
IVE	224XY TWP	CONT. HINGE
JOH	200WF	BARN DOOR TRACK AND HARDWARE
LCN	9553 REG2 MS AS REQ (120/240 VAC)	SURF. AUTO OPERATOR
LCN	SEM7840 12V/24V/120V	MAGNET
LCN	4000T	SURFACE CLOSER
LCN	4040XP EDA	SURFACE CLOSER
LCN	4040XP EDA ST-1956 TBSRT	SURFACE CLOSER
LCN	4040XP RW/PA TBSRT	SURFACE CLOSER
LCN	4040XP SCUSH TBSRT	SURFACE CLOSER
LCN	4040XP ST-1630	SURFACE CLOSER
SCE	PS906 900-2RS 120/240 VAC	POWER SUPPLY
SCH	L9095HDEU 06A CON 12/24 VDC	EU MORTISE LOCK

Mfr	Catalog Number	Description
SCH	80-XXX EV B TYPE AS REQUIRED BY DOOR MFR	CYLINDER
SCH	80-131	SFIC MORTISE CYL.
SCH	80-159	SFIC RIM CYLINDER
SCH	80-037 EV B	SFIC EVEREST CORE
SCH	L9070L 06A LLL LLL LESS LOCK CASE	LEVER TRIM
SCH	L9492HDEU 06A L583-363 RX DM CON 12/24 VDC	EU MORTISE LOCK
SCH	ND10S RHO	PASSAGE SET
SCH	ND40S RHO	PRIVACY LOCK
SCH	ND80HDEU RHO RX 12V/24V DC	EU STOREROOM LOCK
SCH	ND91HD RHO	VANDL OFFICE LOCK
SCH	ND94HD RHO	VANDL CLASSROOM LOCK
SCH	ND96HD RHO	VANDL STOREROOM LOCK
VON	AX-9447-EO-F	FIRE EXIT HARDWARE
VON	AX-9447-L-BE-F-06	FIRE EXIT HARDWARE
VON	EPT10	POWER TRANSFER
VON	RX-PA-3349A-L-BE-E360-06-FS-WH 24 VDC	ELEC PANIC HARDWARE
VON	RX-PA-33A-L-BE-E360-06-299-FS-WH 24 VDC	ELEC PANIC HARDWARE
VON	RX-QELX-PA-AX-3349A-EO-LBL	ELEC PANIC HARDWARE
VON	RX-QELX-PA-AX-3349A-NL-OP-388-LBL	ELEC PANIC HARDWARE
VON	RX-PA-AX-9949-L-M996-06-FSE-LBL	ELEC PANIC HARDWARE
VON	RX-PA-AX-99-L-F-M996-06-FSE	ELEC FIRE EXIT HARDWARE
VON	RX-PA-AX-99-L-M996-06-FSE	ELEC PANIC HARDWARE
VON	RX-QELX-PA-AX-99-L-NL-06	ELEC PANIC HARDWARE
WIK	INGRESS'R I36-3	ACTUATOR
WIK	SQ SERIES 6"x 6" PREPPED FOR INGRESS'R	BOLLARD
ZER	153A	DOOR SWEEP
ZER	188SBK PSA	GASKETING
ZER	188SBK OR BY FRAME MFR	GASKETING
ZER	328AA-S	MEETING STILE
ZER	364AA	DOOR BOTTOM
ZER	39A	DOOR SWEEP
ZER	43SP	ASTRAGAL
ZER	44STST OR BY HM DOOR MFR	ASTRAGAL
ZER	47A	ASTRAGAL
ZER	8192AA	DOOR SWEEP

Accurate
Lock and Hardware

MADE IN USA

www.accuratelockandhardware.com

SL9100ADA

Self Latching Sliding Door Lock

For ADA Sliding Door Applications

- Single Action Egress Sliding Door Lock
- ADA Accessibility features
- Deadbolt for extra security
- 2 1/2" or 2 3/4" backset standard

Inside

Outside

Open Position
SL9100ADA features a barrier free surface when door is in the open position.

Complete Lockset
SL9100ADA is offered complete and includes:
Set of 7200L levers/escutcheons
ADA thumb turn and Emergency Release trim where applicable

The **SL9100ADA** Series feature a self latching bolt that is projected when push button actuator contacts strike.

Single Action Egress: To open door, grasp lever and pull. This will simultaneously retract deadbolt and latch while sliding door open. Lock features no protrusions or snags when in the open position.

SL9100ADA Series is available with 7200L Series levers. Accurate can custom manufacture other lever designs or supply the lock for use with other manufacturers' trim, please call for assistance.

1 Annie Place • Stamford, CT 06902 • P: 203.348.8865 • F: 203.348.5234 • E: sales@accuratelockandhardware.com

SL9100ADA
Self Latching Sliding Door Lock

Series/Function	Description
SL9122ADA	Store Door Lock Latch bolt by lever either side. Deadbolt by key either side. No Emergency Egress.
SL9124ADA	Dormitory, Entrance or Storeroom Latch bolt by lever either side. Deadbolt by key outside, thum bturn inside. A turn of inside lever retracts latch and deadbolt simultaneously, automatically unlocking outside lever.
SL9125ADA	Passage Latch bolt by lever either side
SL9134ADA	Hotel/Motel Latch bolt by lever inside and key outside. Outside lever always rigid. Deadbolt by thumb turn inside. A turn of inside lever retracts latch and deadbolt simultaneously.
SL9139ADA	Privacy Latch bolt by lever either side. Deadbolt by thumb turn and emergency coin turn outside. A turn of inside lever retracts latch and deadbolt simultaneously, automatically unlocking outside lever.
SL9139ADA-i	Privacy x Indicator Latch bolt by lever either side. Dead bolt by thumb turn and emergency coin turn with indicator outside. A turn of inside lever retracts latch and deadbolt simultaneously, automatically unlocking outside lever.
SL9145ADA	Classroom Latch bolt by key outside and lever either side unless outside lever is locked by key.
SL9153ADA	Entrance/Office Latch bolt by key outside and lever either side unless outside lever is locked by thumb turn or key. Key or thumb turn locks or unlocks outside lever.
SL9159ADA	Storeroom Latch bolt by lever inside and key outside. Outside lever always rigid.

SL9100ADA is offered complete (includes lock body, a pair of 7200L levers and ADA thumb turn/ER trim when applicable).
Cylinder not included.

Recommended cylinder lengths	1 3/8" thick door	1 3/4" thick door	2 1/4" thick door
Cylinder one side only	1"	1 1/8"	1 1/4"
Cylinder x cylinder	1"	1"	1 1/8"

How To Specify:

FUNCTION.BACKSET.FINISH.DT

E.g.: SL9153ADA.212.US32D.134

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MADE IN USA

CRL-Blumcraft PA100 and PA110 Series Panic Handles

BLUMCRAFT
A DIVISION OF C.R. LAURENCE CO., INC.

- UL, ULC, and ANSI/BHMA Certified
- For 1/2" or 3/4" (12 or 19 mm) Tempered Glass Doors
- Wide Selection of Exterior Fixed Handles
- Available in Polished and Brushed Stainless, Satin and Polished Brass, and Oil Rubbed Bronze
- Custom Finishes Available By Special Order
- Custom Sizes Ship Within One to Two Weeks

CRL-Blumcraft manufactures a complete line of Panic Handles designed with the 'all-glass' door in mind. These elegant tubular devices give you maximum viewing area and a contemporary look when used on 1/2" or 3/4" (12 or 19 mm) tempered glass doors.

The most popular of these Panics is our PA100 Series. They provide a solution to the strict Americans With Disabilities Act (A.D.A.) Codes that confront every manufacturer and installer of 'all-glass' doors.

The interior portion of the device is a slender 1-1/4" (32 mm) tube stretching across the door and then gently turning upwards to the top of the door, eliminating any interference at the lower half of the door, which must remain clear of obstructions to pass A.D.A. demands.

The operating mechanism is completely concealed within the tube, and retracts a roller latch bolt at the top of the door when pushed gently. Complementing the sleek interior look, we offer a large selection of exterior pull handles that can be as simple as a horizontal handle (Model PA100A) to one that mirrors the interior device (Model PA100D).

All PA100 Series Panic Handles come with a 'dogging' feature that allows you to lock the device in the open position by simply sliding a lever, giving free access during business hours. They also can be used in conjunction with an Electric Strike, allowing for remote keyless entry. For your convenience, Custom Headers are available with all strike hardware installed.

When A.D.A. Codes are not a concern, we also offer our PA110 Series Panic Handles. These Panics are of the same sleek design as the PA100 Series, except they stretch across the door and then bend downward to the bottom of the door, latching at the floor or threshold.

They operate just like the PA100 Series Panics, and have the same 'dogging' feature. Strikes are available for either threshold or no threshold applications providing secure, accurate latching every time.

All of our PA100 and PA110 Panic Handles go through rigorous testing before they leave our manufacturing facility, ensuring that a high quality, dependable Panic will serve your customer for years to come.

Most importantly, they are all UL305, ULC-S132-07, and ANSI/BHMA A156.3-2008, Grade 1 Certified. No other Panic of this type can make this claim, and that puts CRL-Blumcraft Panic Handles a step ahead of all the rest.

For more information on our PA100 and PA110 Series Panic Handles, contact CRL Technical Sales, or visit our web site at **crlaurence.com**.

- Models for Aluminum or Wood Doors Available on Special Order

Contact CRL Technical Sales at (800) 421-6144 in the U.S., (877) 421-6144 from Canada, or (323) 588-1281 International, and ask for Ext. 7700.
You can also send e-mail from the **crlaurence.com** home page. Click on Contact Us, and then click on Technical Sales for Commercial Products.
NOTE: All Access Control Handles on this page function as health and safety tools, and may only be purchased through CRL Authorized Glass Temperers and Door Manufacturers.

CRL-Blumcraft PA100 Series Panic Handle Details

BLUMCRAFT
A DIVISION OF C.R. LAURENCE CO., INC.


Glass Mount Detail at Latch


Rail Mount Detail at Latch


Keyed Access


Glass Mount Detail at Latch With Header and PK Strike


Rail Mount Detail at Latch with Header and ESK Strike


Retainer Plate

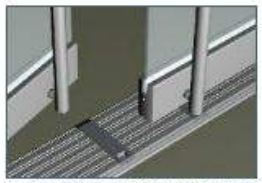
CRL-Blumcraft PA110 Series Panic Handle Details


Glass Mount Detail at Latch


Rail Mount Detail at Latch


Keyed Access


Glass Mount Detail at Latch With Floor Mount Ramp Strike


Rail Mount Detail at Latch With Threshold Ramp Strike


Retainer Plate

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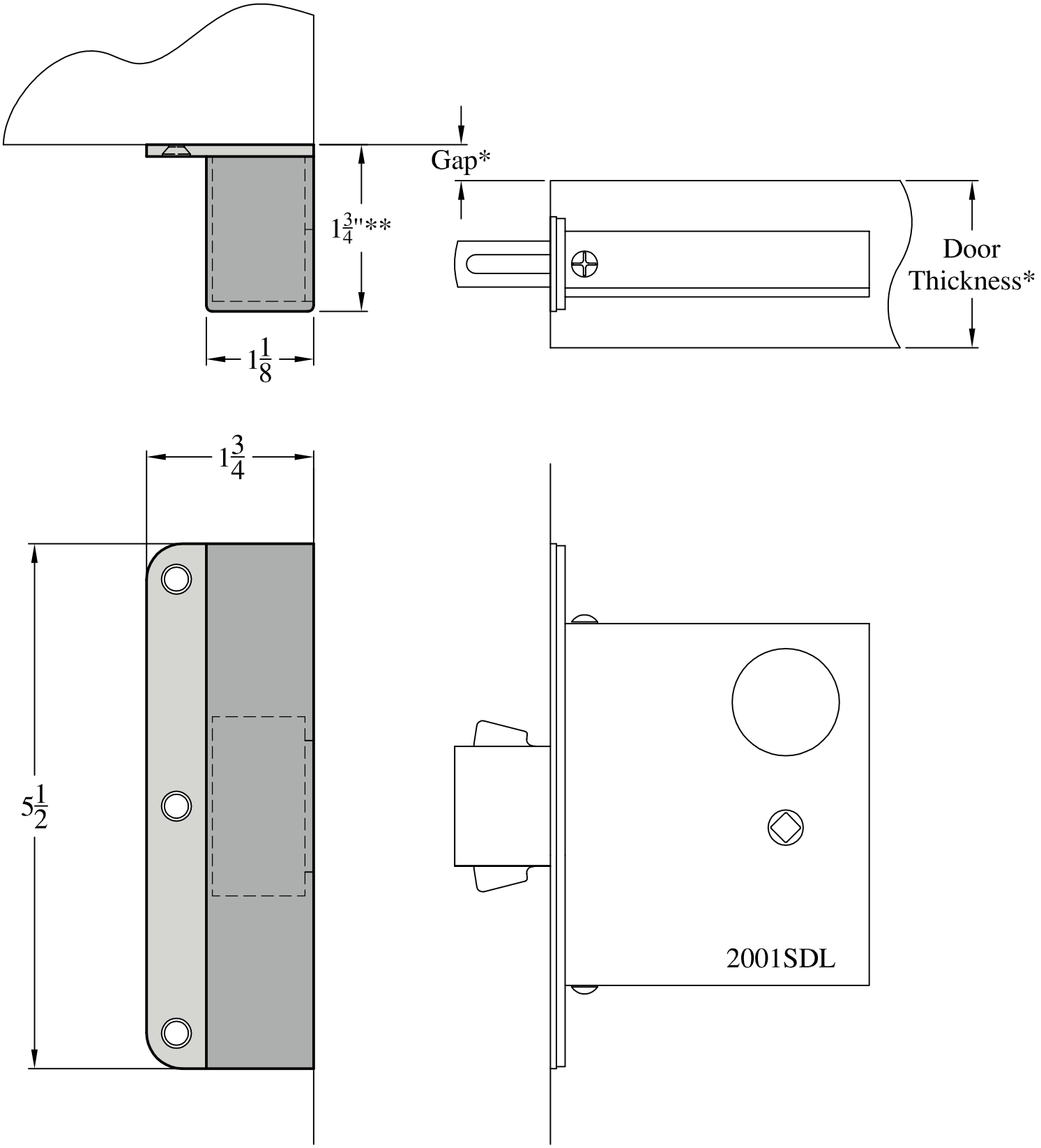
2001BSTK



Corbin Russwin

A member of the Yale Security Group

PG&E Door only

Features

Extra Heavy Duty Cylindrical Lever Locksets
CL3300 Series

Features

Non-Handed

Door Thickness
1 3/4" (44mm) - 2" (51mm) standard.
Optional: 2"(51mm) - 2 1/4" (57mm); see How to Order, page 10.

Backset
2 3/4" (70mm) standard.
Optional: 3 3/4" (95mm) and 5" (127mm); see How to Order, page 10.

Lock Chassis
Steel, zinc dichromated for corrosion resistance.

Front
Wrought brass or bronze, 2 1/4" (57mm) x 1 1/8" (29mm). Accommodates flat doors and doors beveled 1/8" (3mm) in 2" (51mm).
Optional: rounded corners; see How to Order, page 10.

Latchbolt
Brass, chrome plated, 1/2" (13mm) throw .
Optional: 3/4" (19mm) throw deadlocking fire latch for pair of doors; see How to Order,
page 10.

Auxiliary Latchbolt
Deadlocking latchbolt prevents manipulation when door is closed.

Strike
Wrought brass or bronze, ANSI curved lip standard, 4 7/8" (124mm) x 1 1/4" (32mm) x 1 1/4" (32mm) lip to center.
Optional strikes, lip lengths and ANSI wrought strike box available; see How to Order, page 10.

Cylinder
Brass, 6-pin L4 keyway, 0-bitted standard.

Keying Features Available
Master keying
Construction master keying
Visual key control
Concealed key control
Interchangeable core (IC)
High security
High security IC (not available with CL3329)

Keys
Two nickel silver standard.

Warranty
Five-year limited.

Certification/Compliance

ANSI
Meets A156.2 Series 4000, Grade 1.
Meets A117.1 Accessibility Code.

Federal
Meets FF-H-106C.

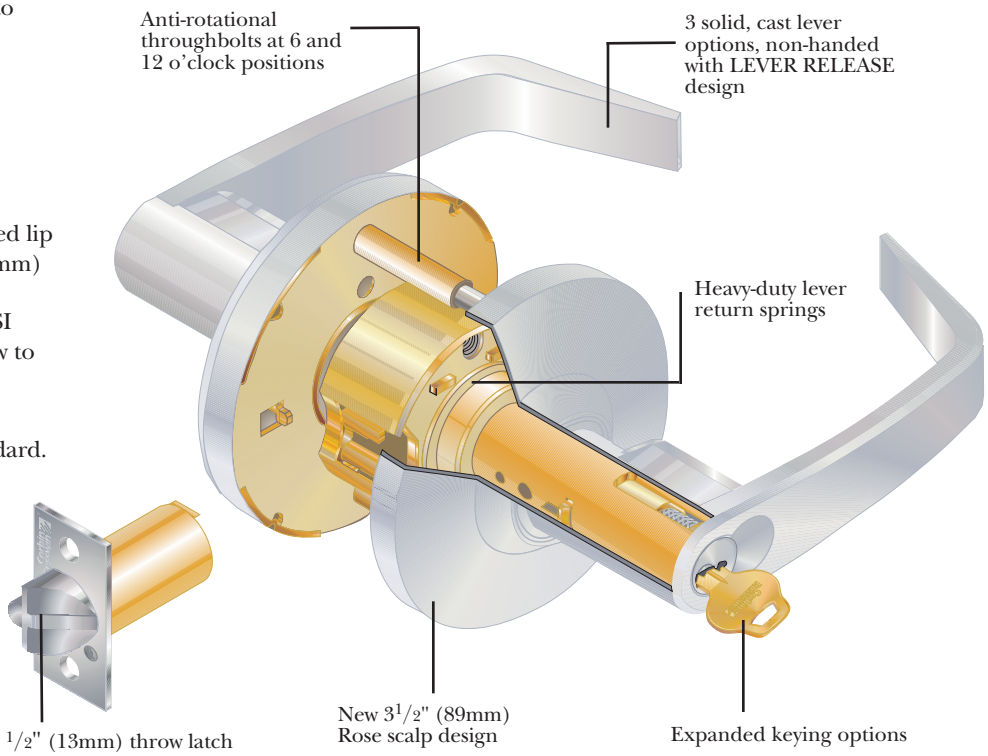
California State Reference Code
(Formerly Title 19, California State Fire Marshal Standard)
All levers with returns comply; levers return to within 1/2" (13mm) of door face.

UL/ULC
All locks with 1/2" (13mm) throw latchbolt listed for A label and lesser class 4' x 10' single doors. All locks with 3/4" (19mm) throw latchbolt listed for A label and lesser class 8' x 10' pairs of doors. Letter F and UL symbol on latch front indicate listing.

Finishes

BHMA 605	Bright Brass
BHMA 606	Satin Brass
BHMA 611	Bright Bronze
BHMA 612	Satin Bronze
BHMA 613	Dark Oxidized Satin Bronze, oil rubbed
BHMA 625	Bright Chromium Plated
BHMA 626	Satin Chromium Plated

Zinc levers are plated to match BHMA finish.

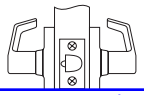
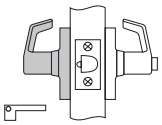
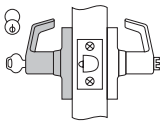
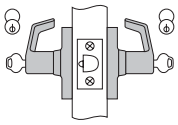
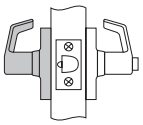
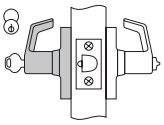
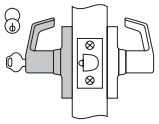
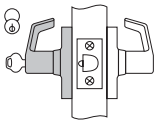
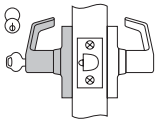


Corbin Russwin®

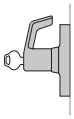
A member of the Yale Security Group

Functions

Extra Heavy Duty Cylindrical Lever Locksets - CL3300 Series

Outside / Inside	Series/ Function	Type	ANSI No. Series 4000	Function Description
 PG&E Door only	CL3310	Passage or Closet	F75	- Latchbolt by lever either side. - Both levers always free.
	CL3320	Privacy Bedroom or Bathroom	F76	- Throw-off latchbolt by lever closing door or by turning inside lever. - Outside lever locked by push button. (Lever handle is free wheeling in locked position.) - Outside lever unlocked by emergency release tool outside, by rotating inside lever or by closing door. - Inside lever always free.
	CL3329	Hotel or Motel	F93	- Throw-off latchbolt by lever inside or by key outside. - Push button shuts out all keys except emergency key, and projects occupancy indicator in face of cylinder. (Lever handle is free wheeling in locked position.) - Push button released by turning inside lever or by closing door.* - Outside lever always locked. - Inside lever always free.
	CL3332	Institutional or Utility	F87	- Deadlocking latchbolt by key either side. (Lever handle is free wheeling in locked position.)
	CL3340	Patio or Privacy	F77	- Throw-off latchbolt by lever closing door or by turning inside lever. - Outside lever locked by push button. (Lever handle is free wheeling in locked position.) - Inside lever always free. - Should not be used in rooms that have no other entrance.
	CL3351	Entrance or Office	F81/F82	- Deadlocking latchbolt by lever either side, except when turn button locks outside lever. Pushing turn button in locks outside lever, requiring use of key outside to unlock. (Lever handle is free wheeling in locked position.) - Turning inside lever unlocks outside lever. - Pushing in and turning button locks outside lever, requiring key at all times. Turning inside lever does not unlock outside lever until button is manually turned to unlocked position. - Inside lever always free.
	CL3355	Classroom	F84	- Deadlocking latchbolt by lever either side, except when key outside locks outside lever. (Lever handle is free wheeling in locked position.) - Outside lever unlocked by key outside. - Inside lever always free.
	CL3357	Storeroom or Closet	F86	- Deadlocking latchbolt by key in outside lever or by rotating inside lever. (Lever handle is free wheeling in locked position.) - Inside lever always free.
	CL3361	Entrance or Office	F82	- Deadlocking latchbolt by lever either side, except when push button locks outside lever. - Push button released by turning inside lever or by key in outside lever. (Lever handle is free wheeling in locked position.) - Closing door does not release push button. - Inside lever always free.

 Indicates optional interchangeable core available; see How to Order, page 11.

 Indicates free wheeling lever in locked position.

*Unless push button has been fixed in locked position by spanner key (furnished). When push button is fixed by spanner key, lock is operable only by emergency key or by display key.

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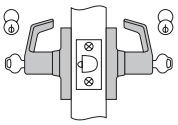
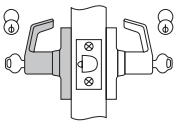
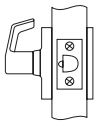
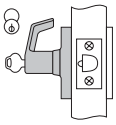
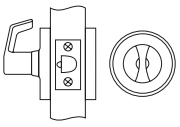
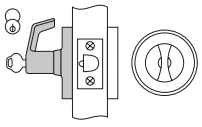
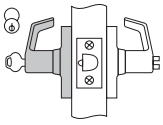
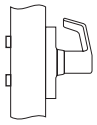
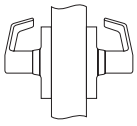
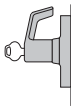
Functions

Extra Heavy Duty Cylindrical Lever Locksets - CL3300 Series

Outside / Inside	Series/ Function	Type	ANSI No. Series 4000	Function Description
	CL3362	Communicating	F80	- Deadlocking latchbolt by lever either side, except when key in either lever locks and unlocks the lever independently of the other. (Lever handle is free wheeling in locked position.) - Keyed alike unless otherwise specified. - Should be used only in office or room with multiple entries.
	CL3372	Apartment, Exit or Public Toilet	F88	- Deadlocking latchbolt by lever either side, except when key inside locks outside lever. (Lever handle is free wheeling in locked position.) - Key outside retracts latchbolt. - Key inside unlocks outside lever. - Inside lever always free. - Keyed alike unless otherwise specified.
	CL3380	Passage Lever x Blank Plate	—	- Deadlocking latchbolt by lever. - Lever on one side; blank plate on other side. - Lever always free. - For single or double communicating doors.
	CL3381	Keyed Lever x Blank Plate	—	- Deadlocking latchbolt by lever, except when lever is locked by key. (Lever handle is free wheeling in locked position.) - Lever on one side; blank plate on other side.
	CL3390	Passage Lever x Turnpiece	—	- Latchbolt by lever or by turnpiece. - Lever on one side; turnpiece on other side. - Lever and turnpiece always free.
	CL3391	Keyed Lever x Turnpiece	—	- Deadlocking latchbolt by lever or turnpiece, except when lever is locked by key. - When lever is locked, latchbolt is operated by key in lever or by turnpiece. (Lever handle is free wheeling in locked position.) - Lever on outside; turnpiece on inside. - Turnpiece always free.
	CL3393	Service Station	F92	- Throw-off latchbolt by lever closing door or by turning inside lever. - Outside lever locked by slotted push button. (Lever handle is free wheeling in locked position.) - When slotted push button is pushed in and turned, outside lever becomes free wheeling and deadlocking latch is activated. Outside lever is unlocked by using key or by rotating inside lever. - Inside lever always free.
	CL3350	Half Dummy Trim	—	- Lever acts as pull only; no operation. - Lever is rigid.
	CL3370	Full Dummy Trim	—	- Levers act as pulls only; no operation. - Lever is rigid.

 Indicates optional interchangeable core available; see How to Order, page 11.

 Indicates free wheeling lever in locked position.

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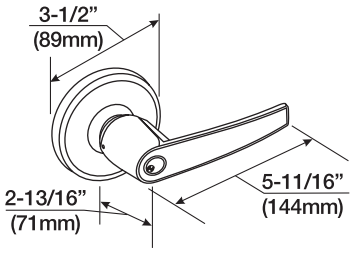
Trim Designs

Extra Heavy Duty Cylindrical Lever Locksets
CL3300 Series

Armstrong

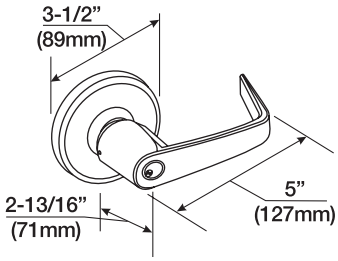


AZD
Lever: Die cast zinc
Rose: Wrought brass or bronze

ASD
Lever: Cast brass
Rose: Wrought brass or bronze

Newport

Complies with codes requiring lever to return to within 1/2" of door face.

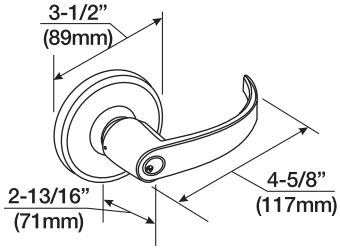


NZD
Lever: Die cast zinc
Rose: Wrought brass or bronze

NSD
Lever: Cast brass
Rose: Wrought brass or bronze

Princeton*

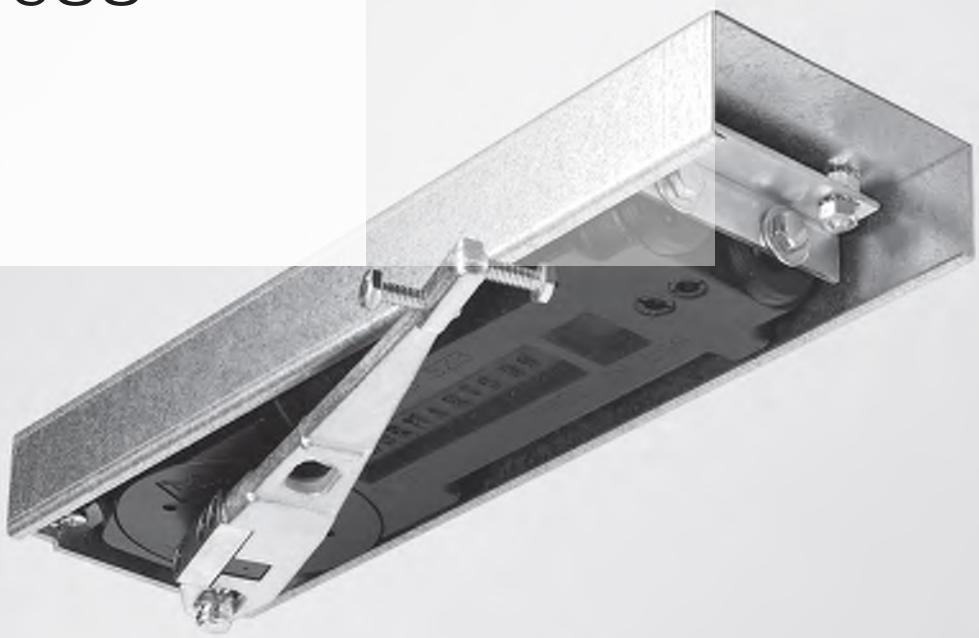
Complies with codes requiring lever to return to within 1/2" of door face.



PZD
Lever: Die cast zinc
Rose: Wrought brass or bronze

* Shipments beginning August 16, 1998.

RTS88



Overhead Concealed Door Closer

DORMA RTS88 OVERHEAD CONCEALED DOOR CLOSER

Invisible door control — Dependable and easy to install

Architects are often challenged to design buildings that are both beautiful and functional, down to the last detail. The DORMA RTS88 overhead concealed door closer offers the perfect solution for those who prefer the aesthetic advantages of a concealed door closer.

The RTS88 is designed to give lasting, dependable service where surface applied units and other types of closers are not suitable, or would interfere with the architectural design. The RTS88 may be easily installed in wood, aluminum, or hollow metal doors and frames, for single and double-acting doors. Contractors appreciate the RTS88 closer, because the majority of door and frame preparation is done prior to installation of the unit, resulting in less on-site machining. The RTS88 is also an excellent replacement closer for problem entrances encountering vandalism of surface applied closers.

The RTS88 Series overhead concealed door closer has a compact body size which fits into a 1-3/4" × 4" header for aluminum frames and is also easily adaptable to wood and hollow metal frame configurations.

Openings fitted with the RTS88 are capable of 90° or 105° maximum opening door swing, trim conditions permitting. Sweep and latch closing speeds are controlled by two noncritical temperature compensating valves to insure constant closing speeds even under the most extreme temperature conditions. A built-in pressure relief valve protects the closer from abuse due to forced closing. A cushion at 90° or 105°, depending on the model selected, helps protect the door, frame, and adjoining structure.

CONTENTS

DORMA USA quality and environmental management systems in Reamstown, PA and Steeleville, IL are certified to ISO 9001:2008 and ISO 14001:2004.

NOTE: Always use an auxiliary stop in conjunction with RTS88 installations.

The RTS88 may be used on doors weighing up to a maximum of 250 lb (interior) or 200 lb (exterior), including all hardware. The closer may be used on exterior doors up to a maximum 3'-6" width and interior doors up to a maximum 4' width.

A complete line of accessories is available for wood, aluminum, and hollow metal applications, both single and double-acting center hung doors, and hinged or offset pivoted single-acting doors.

Other accessories include cover plates for wood, aluminum, and hollow metal frames, and extended spindles for increased clearances at the top of the door. Optional hold open units are available, effective at either 90° or 105°.

Specifications—DORMA RTS88 Series overhead concealed door closer for both single and double-acting doors. The RTS88 will consist of a steel cam, rollers, and springs housed in a compact cast iron body. Closers will be capable of being installed in minimum 1-3/4" × 4" headers. RTS88 will have maximum door opening to 90° or 105°, trim conditions permitting. Sweep and latch speed will be controlled by two noncritical adjustment valves from 90° or 105° to closed. Built-in pressure relief valve will protect the closer from abuse caused by forced closing. A cushion at 90° or 105° will be provided to help protect the door and frame. The RTS88 closer will be available with hold open at 90° or 105°, or without hold open. The RTS BFI and BFE are available with 105° hold open only. Optional extended spindle will be available in 3/16" integral length or 1-3/16" add-on length. Accessories will be available for single and double-acting doors as well as independently hung installations for wood, aluminum, and hollow metal doors and frames.

The RTS88 BFI meets the 5 lb maximum opening force requirement for interior 3'-0" wide center hung single or double-acting doors.

Both the RTS88 BFI and RTS88 BFE are suited for easy retrofit of Jackson, Rixson 608, and similar style closers. The RTS88 BFI and RTS88 BFE are available in 105° NHO and 105° HO only.

Cover Plate Finishes (Steel or Wood Frame)
Standard Sprayed Finishes
Aluminum: 689.
Bronze: 691 (Dull), 690 (Statuary), or 695 (Dark Duranodic).
Gold: 696.
Black: 693.

Optional Plated Finishes
Brass: 605 (Bright) or 606 (Satin).
Bright Bronze: 611 (Bright), 612 (Satin), or 613 (Oxidized Satin Oil Rubbed).
Nickel: 618 (Bright) or 619 (Satin).
Chrome: 625 (Bright) or 626 (Satin).

Cover Plate Finishes (Aluminum Frame)
Standard Sprayed Finishes
Aluminum: 689.
Bronze: 695 (Dark Duranodic).
Black: 693.

Warranty[1]: For details, refer to **Limited Warranty Policy** in the current DORMA Price List.

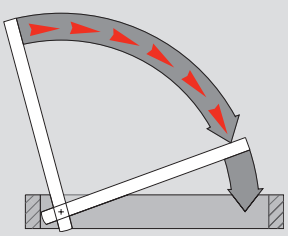
1. Details of DORMA's Limited Warranty Policy may be found in the Limited Warranty Policy section of our current price list. Expressly excluded is warranty for improper installation or misuse of the product. Overtravel or shock loading of the cushion bumper in the RTS88 closer, at the limit of door travel, constitutes misuse and/or improper installation. Always use an auxiliary stop with RTS88 closer installations.

Technical Details

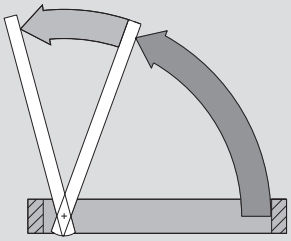
- Compact closer body is designed to fit into headers as small as 1-3/4" × 4".
- Closer body is non-handed.
- One closer for both single-acting or double-acting doors.
- Accommodates maximum door weight of 250 lb (interior) or 200 lb (exterior), including all hardware.
- A pressure relief valve protects closer from damage caused by forced closing.
- An integral cushion limits door swing to 90° or 105°. An auxiliary stop must always be installed in conjunction with RTS88.
- A mechanical backcheck slows down the door prior to contact with the cushion.
- Closing speeds are controlled by two non-critical adjustment valves. Sweep area is from 105° to 20°. Latch area is from 20° to 0°.
- Thermostatic valves insure constant closing speeds under varying temperatures.
- The standard RTS88 is furnished without hold open. Optional single point mechanical hold open is available at 90° or 105°.
- The RTS88 BFI and RTS 88 BFE are available in 105° NHO and 105° HO only.
- The RTS88 offers a cast-iron body along with heavy-duty ball bearings at the spindle.
- Steel cam and roller assembly is coupled to dual steel pistons.
- Mounting brackets are available to install closer into aluminum or wood headers.
- Packages are available for side load, end load, and offset slide arm applications. For independently hung doors with 8812 slide arm, the maximum degree of opening and hold open angle may vary slightly.
- No. 8532 steel header mounting channel is specifically designed to install the RTS series closer into open-throat steel header sections. Normally, the mounting channel is installed in the header prior to shipment to the job site.
- No. 8521E add-on spindle extension is available for special applications where additional clearance is required between the closer body and the door.
- Cover plates are available for virtually any type header material.
- No. 8820J conversion bracket is available for replacement of existing overhead concealed closers with the RTS88.

Technical Details

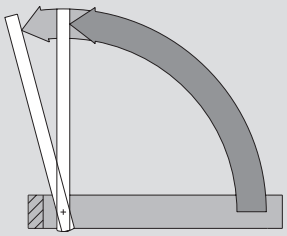
Dual Speed Closing—Sweep and latch closing speeds are controlled by two non-critical adjustment valves. Sweep area is from 105° to 20°. Latch area is from 20° to 0°.



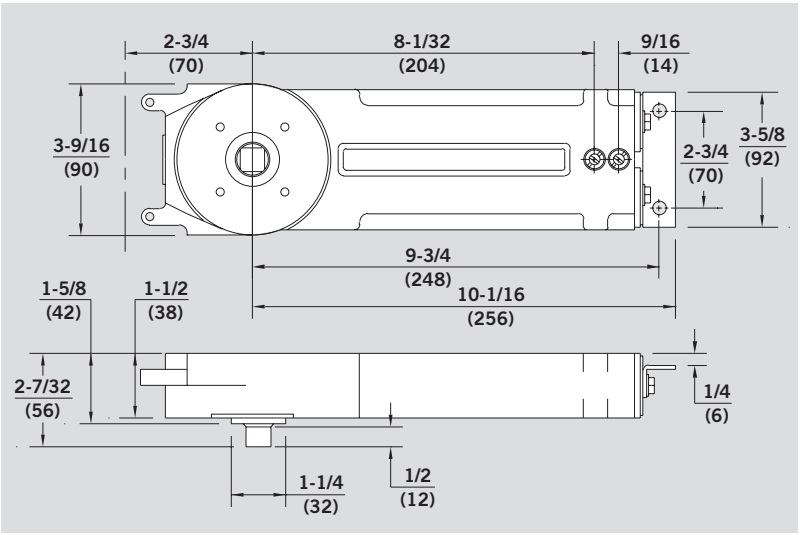
Backcheck—A mechanical backcheck slows the door prior to contact with the cushion.



Cushion—An integral cushion is available at 90° or 105°. Always use an auxiliary stop in conjunction with RTS88 installations.



RTS88 Closer Dimensions



Comparison Chart RTS88 Series

DORMA	RTS88 Side Load	RTS88 End Load	RTS88 Offset Slide Arm
Jackson	101-BE, 101-BF 101-GE, 101-PV 101-U, 101-V 101-S	101-AP, 101-AE 101-PE, 101-P 101-PA, 101-T	201-A4 201-P
Rixson	608SL	608EL 700 800	0608 0700
LCN	6030CP	6030CP	2030
Dor-O-Matic	12000, 22000 13000, 23000 14000, 24000	12000 13000 14000	22500 23500 24500

Since no products are exactly alike, the data on this chart represents our judgment of which products are most similar. Information has been obtained from trade sources. It is not guaranteed nor represented that any specific product exactly equals any other product.

Size Selector Chart RTS88 Series

Maximum Door Width

Interior	Exterior	Closer Size
to 3'-0"	to 2'-6"	2*
over 3'-0" to 3'-6"	over 2'-6" to 3'-0"	3
over 3'-6" to 4'-0"	over 3'-0" to 3'-6"	4

* Size (2) is available for 90° cushion or cushion/hold open only. For 105° applications, substitute the RTS88 BFE for the door ranges shown.

Note:
The listed door widths and recommended sizes are for average conditions. In the case of tall or heavy doors or where doors are subject to wind or draft conditions, the larger closer should be selected and used in conjunction with an auxiliary stop.

Size Selector Chart RTS88 BFI/BFE

Door Width

Interior	Exterior	Lightest Opening Force
3'-0" ♿	—	RTS88 BFI*
—	3'-0"	RTS88 BFE*

♿ The RTS88 BFI meets 5 lb interior maximum opening force on 3'-0" wide center hung doors. The RTS88 BFE has the lightest exterior maximum opening force (8.5 lb) on 3'-0" wide center hung doors.

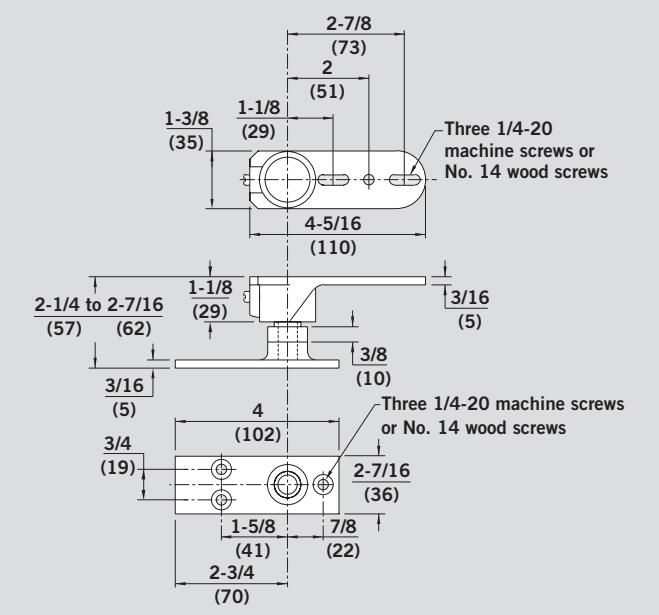
* Available for 105° cushion only or cushion/hold open only.

REDUCED OPENING FORCE INSTALLATIONS CAUTION:
Manual door closers, including closers certified to meet ANSI/BHMA A156.4, when installed and adjusted to conform to ADA or other reduced opening force requirements, may not provide sufficient power to reliably close and latch a door.

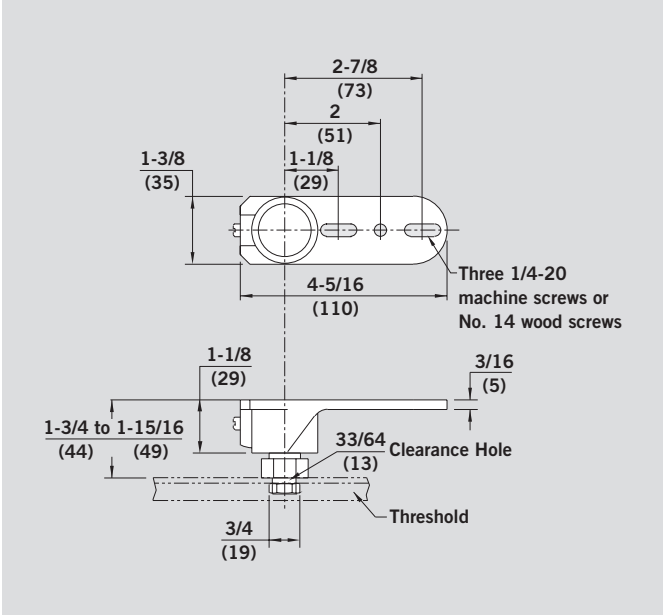
Refer to catalog for Low Energy Operator to meet reduced opening force requirements without affecting closing power.

ACCESSORIES

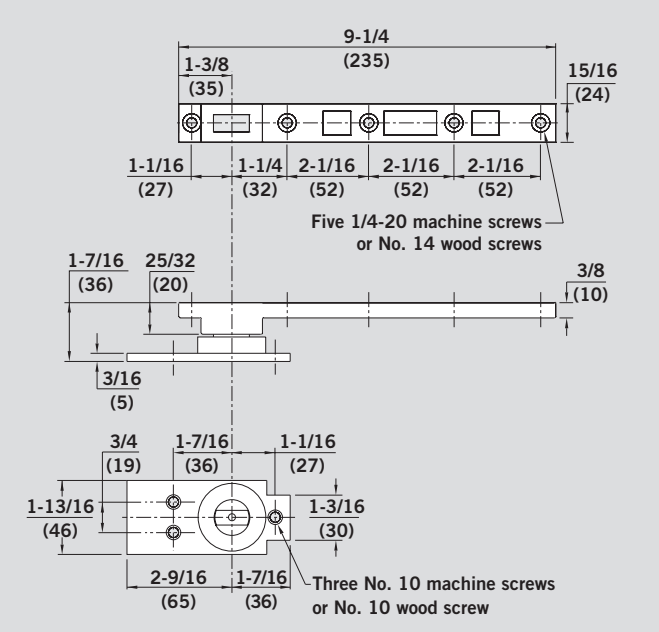
Pivots



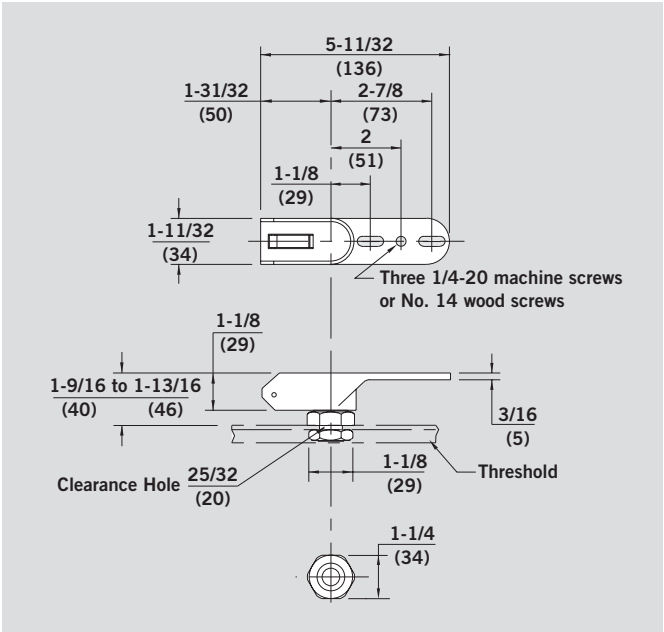
No. 8570 — Adjustable side load floor pivot set for bottom door rail channel depth of 1-15/16". Base can be shortened for 1-9/16" bottom door rail channel depth. Bottom door clearance is adjustable from 5/16" to 1/2". Maximum weight capacity is 200 lb.



No. 8572 — Adjustable side load threshold pivot set for bottom door rail channel depth of 1-9/16". Bottom door clearance is adjustable from 3/16" to 3/8". Maximum weight capacity is 200 lb.

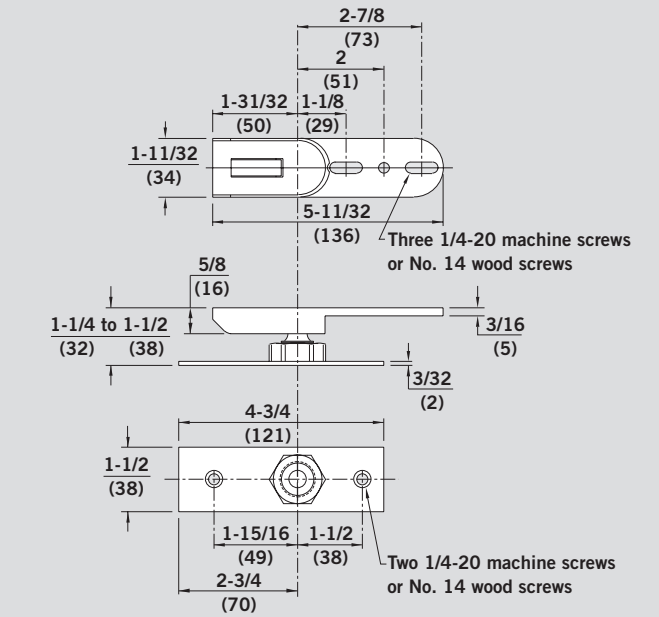


No. 7471K/7421 — Side load floor pivot set. Requires a 1-1/8" mortise depth. Provides a bottom door clearance of 5/16". Weight capacity when used with RTS Series closer is 250 lb. Recommended for wood doors or any door weighing in excess of 200 lb.

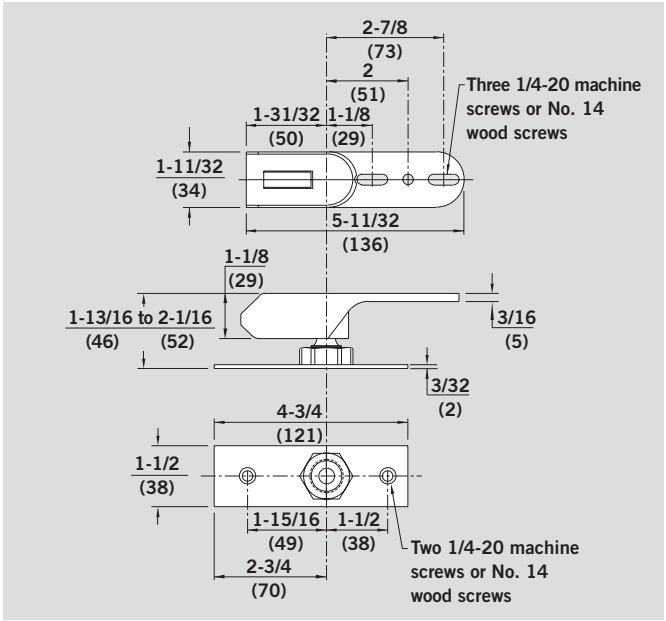


No. 8856 — Adjustable end load threshold pivot set for bottom door rail channel depth of 1-3/8". Bottom door clearance is adjustable from 3/16" to 7/16". Maximum weight capacity is 200 lb.

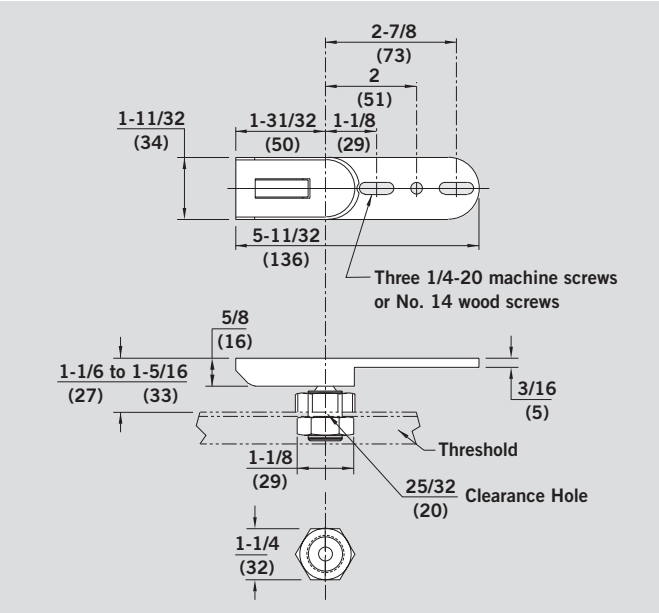
Pivots



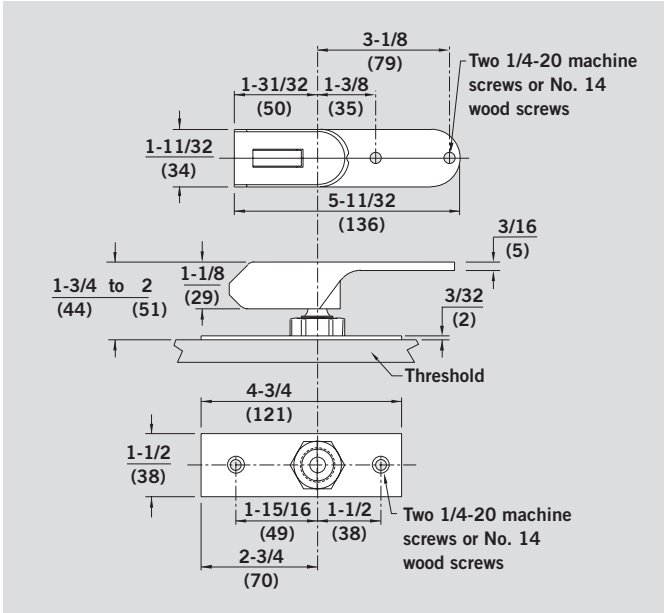
No. 8852 — Adjustable end load floor pivot set for bottom door rail channel depth of 7/8". Bottom door clearance is adjustable from 3/8" to 5/8". Maximum weight capacity is 200 lb.



No. 8853 — Adjustable end load floor pivot set for bottom door rail channel depth of 1-9/16". Bottom door clearance is adjustable from 1/4" to 1/2". Maximum weight capacity is 200 lb.



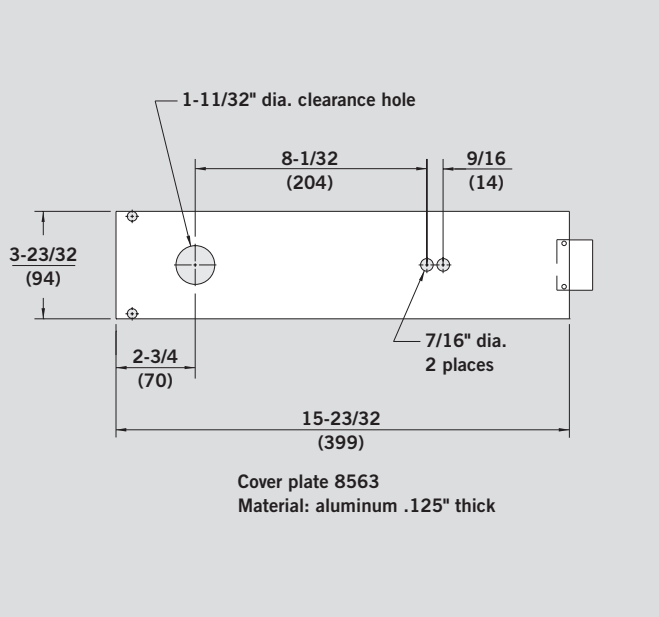
No. 8855 — Adjustable end load threshold pivot set for bottom door rail channel depth of 7/8". Bottom door clearance is adjustable from 3/16" to 7/16". Maximum weight capacity is 200 lb.



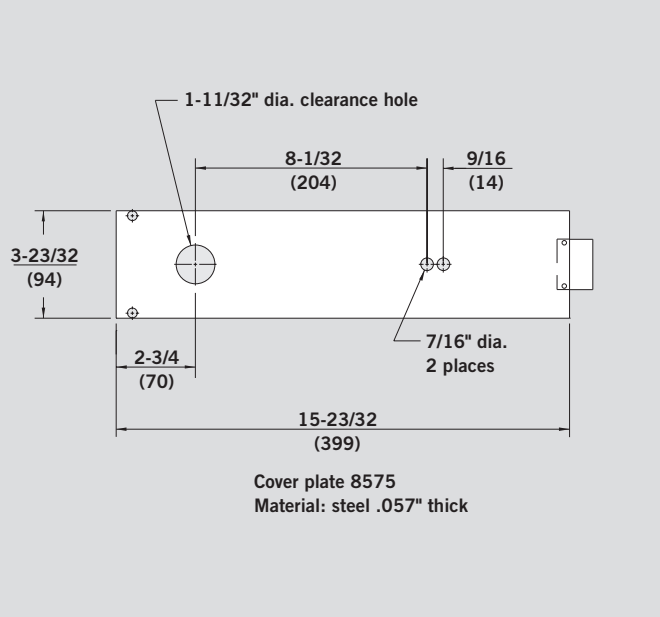
No. 8857 — Adjustable end load threshold pivot set for bottom door channel depth of 1-9/16". Bottom door clearance is adjustable from 3/16" to 7/16". Maximum weight capacity is 200 lb.

ACCESSORIES

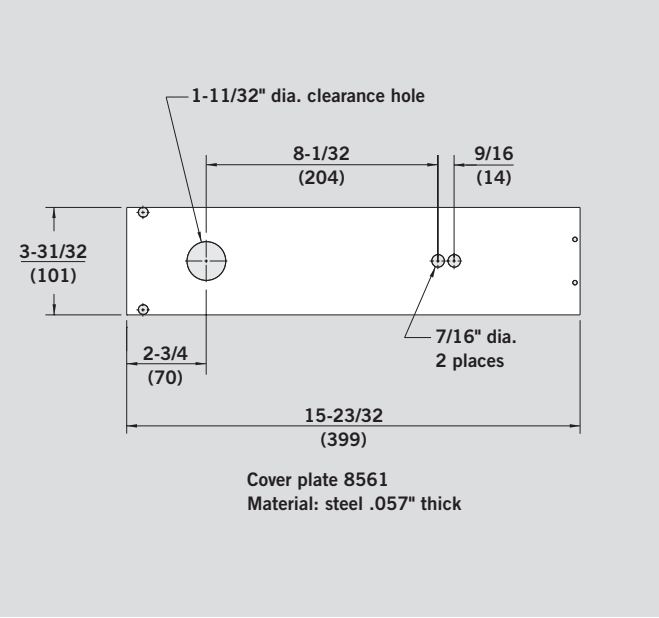
Cover Plates



No. 8563 — Cover plate for RTS Series closer when installed in aluminum header.

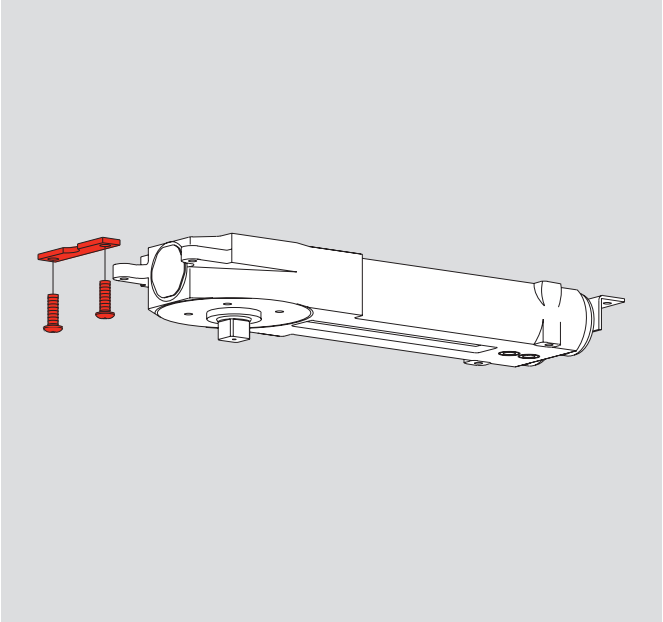


No. 8575 — Cover plate for RTS Series closer when installed in steel header.

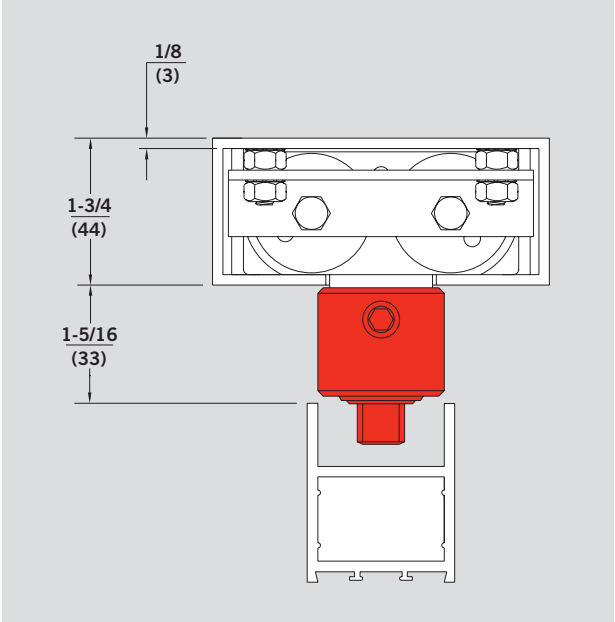


No. 8561 — Cover plate for RTS Series closer when installed in wood header.

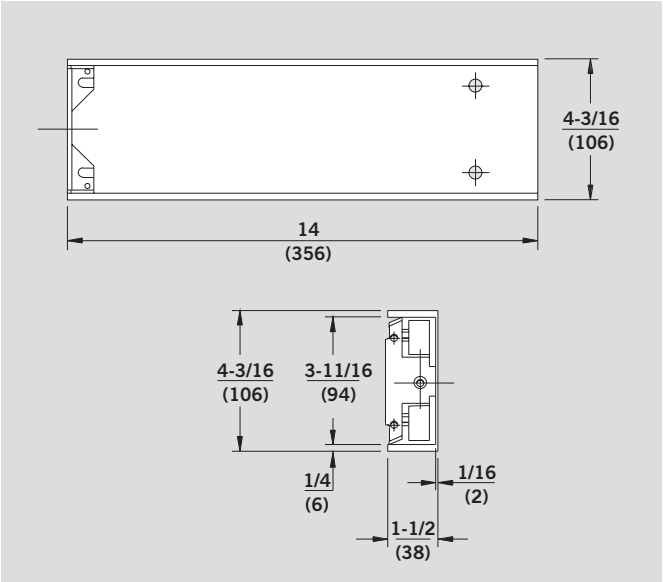
Miscellaneous Accessories



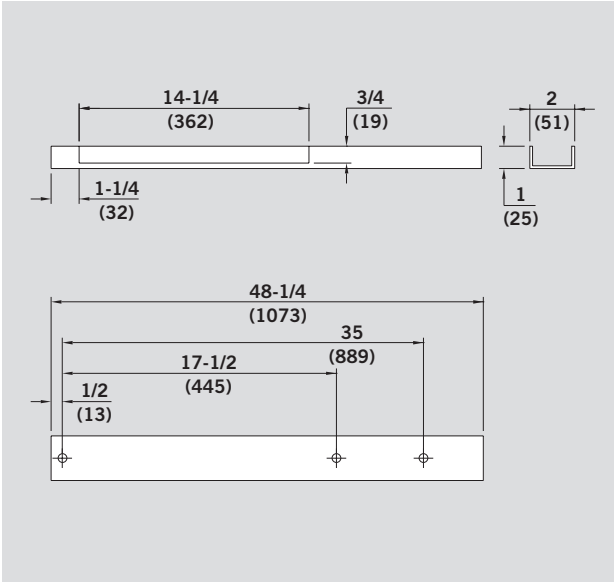
No. 8820J — Conversion bracket for replacement of existing overhead concealed closers. Utilizes existing side jamb mounting bracket to anchor RTS Series closer.



No. 8521E — Add-on spindle extension increases distance between closer and door by 1-3/16" (30 mm).



No. 8532 — Steel header mounting channel. Provides reinforcement required to install the RTS Series closer in an open-throat header.



No. 8511 — Offset slide arm cover. Conceals No. 8812 slide arm when door is in the closed position. The extruded aluminum cover is 48-1/4" long and is field-sized as required. Specify hand.

DORMA

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100 Series Concealed Overhead Door Holders/Stops

100 Series Heavy-Duty

Glynn-Johnson offers a complete line of overhead door holders and stops, accommodating virtually all openings with solutions for even the most complex door control problems. These concealed holders and stops provide the most attractive and reliable heavy-duty door control available.

Glynn-Johnson 100 series holders and stops provide the most reliable and versatile concealed overhead door control. They are designed for installation on virtually all types of doors mounted on conventional type butt hinges, pivots, continuous hinges, swing clear hinges and numerous other specialty hinges. When used in conjunction with many surface-applied door closers, 100 series holders and stops provide the most effective control for entrance doors and vestibule doors of all types, as well as heavy or often used interior doors. Templates provided allow for variable mounting positions, ranging from 85° - 110° of opening.

Five Models:
- 100H Series Hold-Open Model
- 100HP Series Internal Hold-Open Model
- 100F Series Friction Hold-Open Model
- 100S Series Stop-Only Model
- 100SE Series Special Stop-Only Model

Six Sizes:
- Each model comes in six sizes.
- Simple
- Standardized

Three Options:
- ADJ—Adjustable Jamb Bracket
- CJ—Jamb Bracket for use with LCN5030 Closer
- SOC—Pin-in-Socket Security Screw Package

Unmatched Convenience:
- Non-handed
- Improved Compatibility with Door Closers
- Single/Double-Acting Doors
- Interior/Exterior Applications
- Reduced Door Prep
- Durable
- Improved Corrosion Resistance
- Function Conversion Kits are Available.

Materials and Finishes:
In Heavy Gauge Brass or 300 Series Stainless Steel, these models offer the broadest range of finishes in the industry, complementing any design and offering the highest resistance to corrosion. Available in the following finishes:

Finishes	Description
US3	Polished Brass
US4	Satin Brass
US10	Satin Bronze
US10B	Oil Rubbed Bronze
US32	Polished Stainless Steel
US32D	Satin Stainless Steel
SP4	Powder Coat Brass
SP10	Powder Coat Bronze
SP28	Powder Coat Aluminum
SP313	Powder Coat Dark Bronze
SPBLK	Powder Coat Black

Models

These models provide a wide range of optional features, and are ideal for use on entrance and vestibule doors, large doors, doors opened frequently, or doors subject to abuse. These models are also furnished with an offset-style jamb bracket.

Designed for heavy-duty applications, 100 series models will provide long-lasting protection to doors, frames, hinges, related hardware and surrounding walls or obstructions.

100H Series Hold-Open

(Suffix H) The Hold-Open function should be used where it is desired to hold a door open at a predetermined position for short or long periods of time, permitting an unobstructed traffic flow through the opening.

These models are both selective and adjustable, featuring the most reliable Hold-Open mechanism available. They feature a control knob which protrudes from the face of the door and turns the Hold-Open function on or off. Set in the inactive position, the unit acts as a stop and shock absorber. The tension on the Hold-Open mechanism can be adjusted using an allen wrench to offset air currents or other exterior conditions. The Hold-Open tension adjustment is located in the bottom of the track in the top of the door.

100HP Series Internal Hold-Open

These models provide a Hold-Open unit with the Hold-Open mechanism built into the channel, thus reducing the door prep. The 100HP have a preset Hold-Open force that is not adjustable. The Hold-Open feature is not selectable in these units, so the doors are always held open.

100F Series Friction Hold-Open

(Suffix F) Friction Hold-Open models provide an alternative holding method, ideal for heavy patient room doors, closet doors or similar applications where multiple Hold-Open positions are desired. The friction tension is adjusted using an allen wrench and an open end wrench. The friction tension adjustment is located on the top of the slider in the channel.

100S Series Stop-Only

(Suffix S) When the Hold-Open function is not required, the Stop-Only function provides the same effective door control minus the Hold-Open feature. The Stop-Only model may be used on fire doors.

100SE Series Special Stop-Only

(Suffix SE) When Stop-Only models are used in conjunction with single point Hold-Open electronic door closers, they may be ordered without the shock-absorbing mechanism. Used as an auxiliary stop with these closers, they will prolong the life of the closer. The stop location is adjusted using an allen wrench on the stop block located in the channel.

Note: Caution should be used when using this option in other applications, as the elimination of the shock-absorbing spring can put added stress on door and frame if used improperly.

Application Information

UL Classification

The 100 series Stop-Only models are classified by Underwriters Laboratories (UL) as Miscellaneous Fire Door Accessories. This classification applies to use on either Hollow Metal Fire Doors or Wood Fire Doors. Where Wood Door manufacturer's listing allows for the cutout required for installation, concealed overhead stops may be used on those wood fire doors. These units may be used on doors of any rating. As a reminder, the Miscellaneous Fire Door Accessories (GVUX) section is defined by UL as: "Miscellaneous fire door accessories are intended in the individual Listings. The accessories have been investigated to determine that when installed in accordance with the manufacturer's instructions, the accessories do not adversely affect the fire rating of the fire door and/or fire door frames."

Dead Stop Templating:

If a wall or similar obstruction is in place at 110° or less opening angle (i.e. doors that open back-to-back), Dead Stop Templating should be used. This includes all Hold-Open, Friction and Stop-Only models, except when the "SE" Option is used. The Dead Stop position is reached when the shock-absorbing spring is fully compressed, the initial degree of opening will be 5° to 7° less than the Dead Stop opening.

Example: If the holder is templated to 100° Dead Stop, the door will hold open somewhere between 93° and 95°, but no further than 100°.

Note: Do not use dead-stop templating on the 100SE Series since there is no shock-absorbing spring.

Environmental Considerations:

Environmental factors should always be considered when specifying overhead holders and stops. Doors that are positioned on a building's exterior or subject to corrosive conditions should be equipped with a holder constructed primarily of stainless steel or brass materials. For interior applications, steel is acceptable, though brass substrates generally provide a more attractive architectural-grade finish.

Function Conversion Kits

- FK100F—Converts a 100H or 100S unit into a 100F unit. To order specify FK100F.
- FK100H—Converts a 100F or 100S unit into a 100H unit. To order specify FK100H.
- No kit is needed to convert a 100H or 100F unit into a 100S unit.

Options

Suffix ADJ (Adjustable Jamb Bracket):

An additional option on the 100 series is the adjustable jamb bracket, which allows the degree of Hold-Open or Stop angle to be adjusted after installation. Suffix "ADJ" is available in all functions, but only in sizes 3, 4, 5 & 6. ADJ jamb bracket requires additional frame prep. The ADJ option cannot be added to an existing unit, it must be factory ordered.

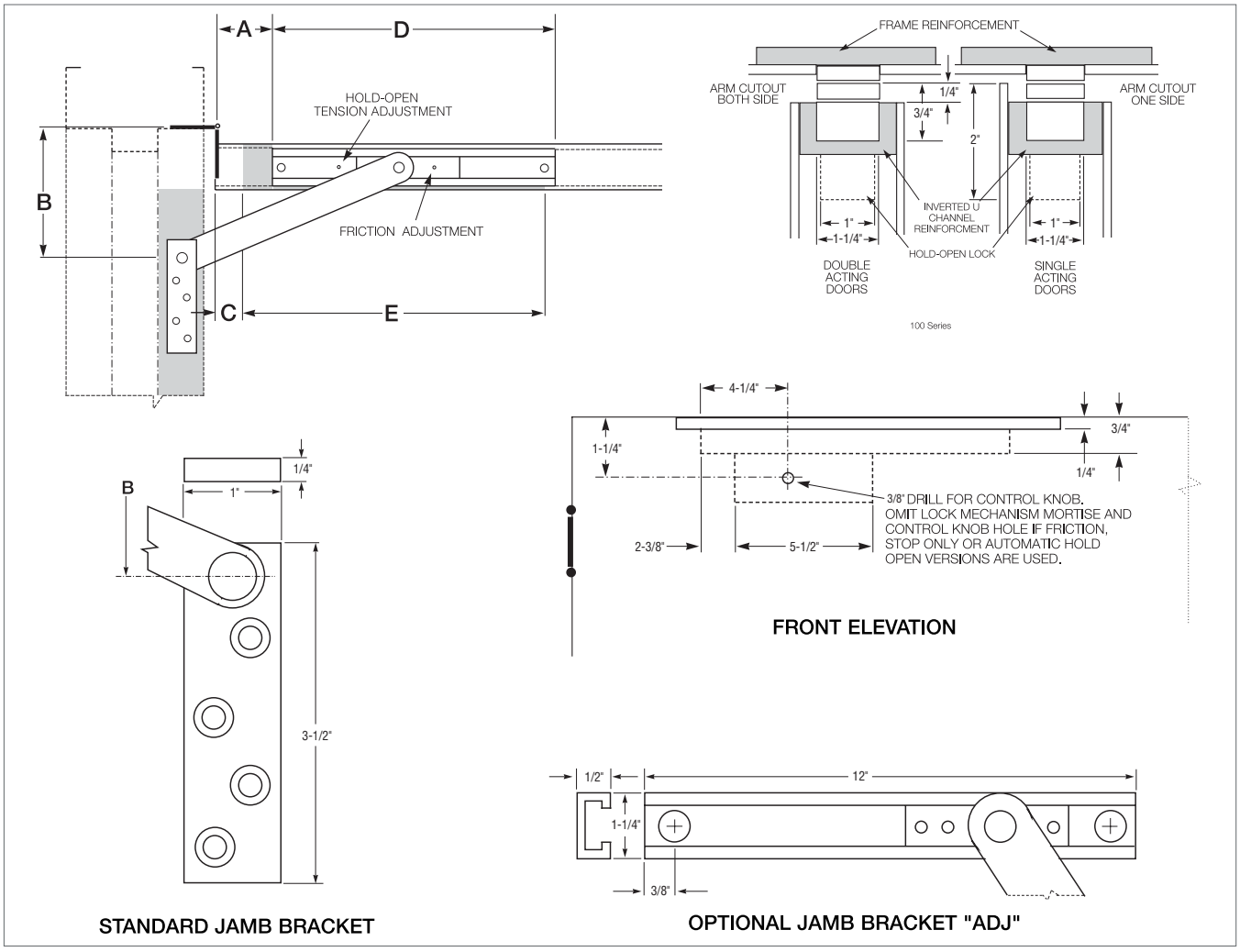
Suffix CJ (Closer Jamb Bracket):

Provides a special jamb bracket needed for 100 series units used with LCN5030 closers. These special jamb brackets are handed, so handing will need to be specified when ordering the "CJ" option, CJLH for a left hand door and CJRH for a right hand door. The CJ option cannot be added to an existing unit, it must be factory ordered.

Suffix SOC (Pin-in-Socket Security Screw Package):

A screw package with pin-in-socket screws for mounting the jamb bracket to the frame is provided instead of the standard screw package.

100 Series Concealed Overhead Door Holders/Stops



100 Series Sizing Chart

	BUTTS/OFFSET PIVOTS				CENTER HUNG			
SIZE	DOOR OPENING	STOP ONLY	HOLD OPEN	FRICTION	DOOR OPENING	STOP ONLY	HOLD OPEN	FRICTION
1	18"–23"	101S*	101H*	101F*	-----	----	----	----
2	23-1/16"–27"	102S*	102H*	102F*	-----	-----	-----	-----
3	27-1/16"–33"	103S	103H	103F	33-1/16"–39"	103S	103H	103F
4	33-1/16"–39"	104S	104H	104F	39-1/16"–45"	104S	104H	104F
5	39-1/16"–45"	105S	105H	105F	45-1/16"–51"	105S	105H	105F
6	45-1/16"–54"	106S	106H	106F	51-1/16"–59"	106S	106H	106F

Note: This chart illustrates the most common types of hinging and door opening sizes. For unusual door details, contact Glynn-Johnson for availability.

**These sizes are not available for use with offset pivots. Also not available with the ADJ option.*

BHMA/ANSI, A156.8 & FED. Spec. Cross Reference		
G-J Model	BHMA*	FED. Spec.
101-106 H	C01511	1160
101-106 S	C01541	----
101-106 F	C01531	----

** First numeral (0) designates optional material.*

To specify:
Brass material, change 0 to 1 (i.e. C11511)
Stainless Steel material, change 0 to 5 (i.e. C51511)

BHMA

All 100 series models are designed for heavy-duty applications and far exceed BHMA cycle test and force test requirements for Grade 1 holders and stops.

The template information on this page is for reference only and is not intended to serve as an installation template. For complete dimensional information, refer to Glynn-Johnson template book.

90 Series Surface Overhead Door Holders/Stops

90 Series Heavy-Duty

Glynn-Johnson 90 series holders and stops are the most rugged models available for heavy-duty applications. The channel is surface-mounted to the door, most often with sex bolts, and the jamb bracket is surface mounted to the jamb, requiring minimal door and frame preparation.

These versatile units can be used in conjunction with most surface-applied door closers. The provided templates allow for variable mounting positions, ranging from 85º to 110º Hold-Open/Stop angle. These templates are designed for installation in almost all types of doors, including doors with conventional butt-type hinges or specialty hinges.

Four Models:
- 90H Series Hold-Open Model
- 90S Series Stop-Only Model
- 90F Series Friction Hold-Open Model
- 90SE Series Special Stop-Only Model

Five Sizes:
- Simple
- Standardized
- Each model is available in five sizes

Three Options:
- J—Angle Jamb Bracket
- SHIM—Blade Stop Shim Kits
- SOC—Pin-in-Socket Security Screw Package

Unmatched Convenience:
- Non-Handed
- Improved Compatibility with Door Closers
- Single-Acting Doors
- Interior/Exterior Applications
- Durable
- Easy to Install
- Improved Corrosion Resistance
- Function Conversion Kits Available

Materials and Finishes:
In 300 series Stainless Steel, Brass and Steel substrates, these models are available in the largest selection of finishes in the industry. Stainless Steel models offer the highest resistance to corrosion. Available in the following finishes:

Finish	Description
US3	Polished Brass
US4	Satin Brass
US10	Satin Bronze
US10B	Oil Rubbed Bronze
US32	Polished Stainless Steel
US32D	Satin Stainless Steel
SP4	Powder Coat Brass
SP10	Powder Coat Bronze
SP28	Powder Coat Aluminum
SP313	Powder Coat Dark Bronze
SPBLK	Powder Coat Black
652	Chrome-like Coating

Models

Glynn-Johnson 90 series door holders and stops provide long-lasting protection for doors, frames and hardware. All models incorporate a heavy-duty channel/slide-arm design and offset jamb bracket. This unique design allows for simple field modification of functions, should user requirements change.

90H Series Hold-Open

(Suffix H) Hold-Open models provide a convenient method of holding the door open at a predetermined position for short or long periods of time, permitting an unobstructed traffic flow through the opening. The Hold-Open function can easily be turned on or off by simply rotating the serrated knob on the bottom of the channel. This knob engages the Hold-Open mechanism, allowing the door to be held open at a predetermined position ranging from 85º to 110º. When the knob is flipped over, it acts as a stop and shock absorber.

The tension on the Hold-Open mechanism can be adjusted using a phillips screwdriver to offset air currents or other exterior conditions. The Hold-Open tension adjustment is located on the top of the slider in the channel.

90S Series Stop-Only

(Suffix S) When the Hold-Open function is not a requirement, Stop-Only models provide a reliable method of door control. Stop-Only models provide the same shock-absorbing capability as Hold-Open models. The Stop-Only model may be used on fire doors.

90F Series Friction Hold-Open

(Suffix F) Friction Hold-Open models are ideal for patient room doors, wardrobe and closet doors or similar applications where multiple Hold-Open positions are desired. The friction tension can be adjusted through the top of the channel using an allen wrench. The friction tension adjustment is located on the top of the slider in the channel.

90SE Series Special Stop-Only

(Suffix SE) When Stop-Only models are used in conjunction with single-point, Hold-Only electronic door closers, the Stop-Only function may be ordered without the shock-absorbing mechanism. Used as an auxiliary stop, these models prolong the life of the closer. The stop location is adjusted using an allen wrench on the stop block located in the channel.

Note: Caution should be taken when using this option in other applications, as the elimination of the shock-absorbing spring can put added stress on the door and frame.

Application Information

UL Classification

The 90 series Stop-Only models are classified by Underwriters Laboratories (UL) as Miscellaneous Fire Door Accessories. This classification applies to use on either Hollow Metal Fire Doors or Wood Fire Doors. These units may be used on doors of any rating. As a reminder, the Miscellaneous Fire Door Accessories (GVUX) section is defined by UL as: "Miscellaneous fire door accessories are intended in the individual Listings. The accessories have been investigated to determine that when installed in accordance with the manufacturer's instructions, the accessories do not adversely affect the fire rating of the fire door and/or fire door frames."

Dead-Stop Templating:

Dead-stop templating is recommended for applications where a wall or similar obstruction is placed at an opening angle of 110º or less (i.e., doors that open back-to-back). Dead-stop templating can be applied to Hold-Open, Stop-Only and Friction models. The Dead-Stop position is the point at which the shock-absorbing spring is fully compressed. Therefore, when Dead-Stop Templating is used, the initial degree of opening will be 5º to 7º less than the Dead-Stop opening.

Example: If the holder is templated to a 100º Dead Stop, the door will hold open at an angle between 93º and 95º but no further than 100º

Note: Do not use dead-stop templating on the 90SE Series since there is no shock-absorbing spring.

Environmental Considerations:

Environmental factors should always be considered when specifying overhead holders and stops. Doors that are positioned on a building's exterior or subject to corrosive conditions should be equipped with a holder constructed primarily of stainless steel or brass materials. For interior applications, steel is acceptable, though brass substrates generally provide a more attractive architectural-grade finish.

Function Conversion Kits

- FK90H—Converts a 90F or a 90S unit into a 90H unit. To order specify FK90H.
- FK90F—Converts a 90H or a 90S unit into a 90F unit. To order specify FK90F.
- FK90SE—Converts a 90H, 90F or a 90S unit into a 90SE unit. To order specify FK90SE–Finish.
- No kit is needed to convert a 90H or 90F unit into a 90S unit.

Options

Suffix J (Angle Jamb Bracket):

An angle jamb bracket is available for converting standard models to hinge-side or flush transom mounting. The angle jamb bracket affixes to the standard jamb bracket. If ordered with the unit add suffix J. If needed separately order 90J by finish needed.

Suffix SOC (Pin-in-Socket Security Screws):

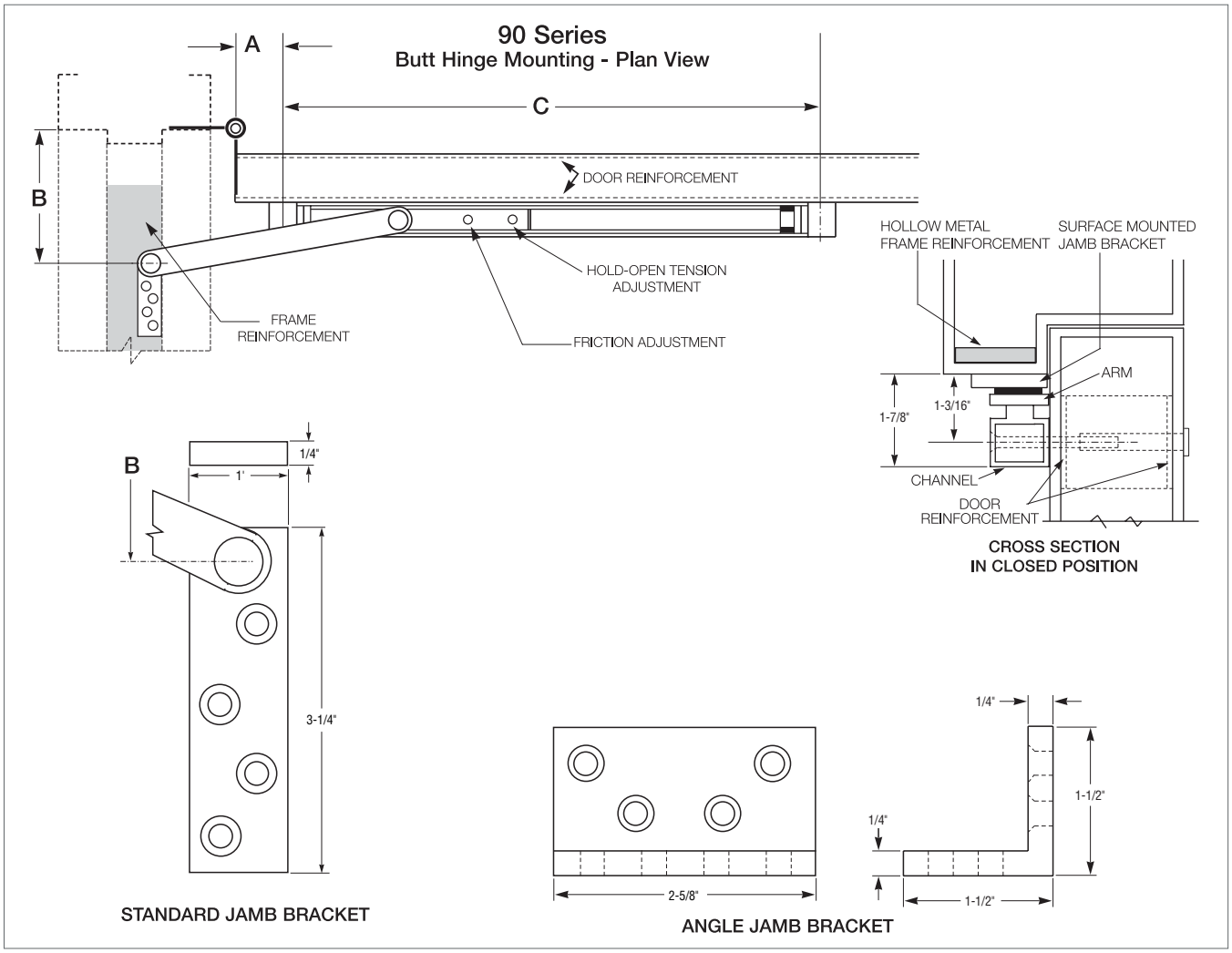
A screw package with pin-in-socket screws for mounting the door bracket and the jamb bracket is provided instead of the standard screw package.

Suffix SHIM (Blade Stop Shims):

Shim kits are available in 3 sizes
90 SHIM1 is a 1/4" Shim Kit
90 SHIM2 is a 1/2" Shim Kit
90 SHIM3 is a 3/4" Shim Kit

If ordered with overhead, add suffix SHIM (1, 2 or 3). If needed separately order 90 SHIM (1, 2 or 3)–Finish.

90 Series Surface Overhead Door Holders/Stops



90 Series Sizing Chart								
BUTTS/OFFSET PIVOTS					**CENTER HUNG**			
SIZE	**DOOR OPENING**	**STOP ONLY**	**HOLD OPEN**	**FRICTION**	**DOOR OPENING**	**STOP ONLY**	**HOLD OPEN**	**FRICTION**
1	-----	-----	-----	-----	-----	----	----	----
2	23-1/16"–27"	902S	902H	902F	27-1/16"–33"	902S	902H	902F
3	27-1/16"–33"	903S	903H	903F	33-1/16"–39"	903S	903H	903F
4	33-1/16"–39"	904S	904H	904F	39-1/16"–45"	904S	904H	904F
5	39-1/16"–45"	905S	905H	905F	45-1/16"–51"	905S	905H	905F
6	45-1/16"–51"	906S	906H	906F	51-1/16"–59"	906S	906H	906F

Note: This chart illustrates the most common types of hinging and door opening sizes. For unusual door details, contact Glynn-Johnson for availability.

BHMA/ANSI, A156.8 & FED. Spec. Cross Reference		
G-J Model	**BHMA***	**FED. Spec.**
902 - 906H	C02511	1161
902 - 906S	C02541	1161A
902 - 906F	C02531	—

** First numeral (0) designates optional material.*

To specify:
Brass material, change 0 to 1 (i.e. C12511)
Stainless Steel material, change 0 to 5 (i.e. C52511)
Steel material, change 0 to 8 (i.e. C82511)

The template information on this page is for reference only and is not intended to serve as an installation template. For complete dimensional information, refer to Glynn-Johnson template book.

How to Order

90 4 H – US32D – J

Overhead Series:
- **90**

Size (Door Opening Using Butts or Offset Pivots):
- **2** (23-1/16"–27")
- **3** (27-1/16"–33")
- **4** (33-1/16"–39")
- **5** (39-1/16"–45")
- **6** (45-1/16"–54")

Function:
- **H** Hold-Open
- **F** Friction Hold-Open
- **S** Stop-Only
- **SE** Special Stop-Only

Finishes:
- **US3** Polished Brass
- **US4** Satin Brass
- **US10** Satin Bronze
- **US10B** Oil Rubbed Bronze
- **US32** Polished Stainless Steel
- **US32D** Satin Stainless Steel
- **SP4** Powder Coat Brass
- **SP10** Powder Coat Bronze
- **SP28** Powder Coat Aluminum
- **SP313** Powder Coat Dark Bronze
- **SPBLK** Powder Coat Black
- **652** Chrome-like Coating

Options:
- **J** Angle Jamb Bracket
- **SHIM** Blade Stop Shims—
  - SHIM1–1/4" Kit
  - SHIM2–1/2" Kit
  - SHIM3–3/4" Kit
- **SOC** Pin-in-Socket Security Screws

How to Order

10 4 H – US26D – ADJ

Overhead Series:
- **10**

Size (Door Opening Using Butts or Offset Pivots:
- **1** (18"–23")
- **2** (23-1/16"–27")
- **3** (27-1/16" –33")
- **4** (33-1/16"–39")
- **5** (39-1/16"–45")
- **6** (45-1/16"–54")

Function:
- **H** Hold-Open
- **HP** Internal Hold-Open
- **F** Friction Hold-Open
- **S** Stop-Only
- **SE** Special Stop-Only

Finishes:
- **US3** Polished Brass
- **US4** Satin Brass
- **US10** Satin Bronze
- **US10B** Oil Rubbed Bronze
- **US32** Polished Stainless Steel
- **US32D** Satin Stainless Steel
- **SP4** Powder Coat Brass
- **SP10** Powder Coat Bronze
- **SP28** Powder Coat Aluminum
- **SP313** Powder Coat Dark Bronze
- **SPBLK** Powder Coat Black

Options:
- **ADJ** Adjustable Jamb Bracket
- **CJLH** Special Jamb Bracket for LCN 5030 Closer, LH Door
- **CJRH** Special Jamb Bracket for LCN 5030 Closer, RH Door
- **SOC** Pin-in-Socket Security Screws

Meets ANSI A156.3 Type 25.
UL Listed 3 Hour Fire Doors 8'0" x 10'0"

FB31P Top and Bottom Bolts (Pair)

- Fully Automatic—inactive door is latched, bolts are extended when active door closes, door is unlatched, bolts retract when active door is opened.
- Low Actuation Forces—Top Bolt Has No Spring Tension.
- Fits standard ANSI A115.4 Door Frame Preparations.
- Non-handed.
- Bolt throw is 3/4" with a 7/8" vertical adjustment.
- Bolt backset is 3/4"
- Standard Rod Length is 12", which is measured from the center of the flush bolt body to the bolt tip. Optional rod lengths available for top bolt only on non-fire rated openings—18", 24", 36" and 48.

DP1 or DP2 optional dust proof strike available, see page C11.

FB31T Top Bolt Only
FB31B Bottom Bolt Only

Meets ANSI A156.3 Type 25.
UL Listed 3 Hour Fire Doors 8'0" x 8'0"

FB32 Top Bolt with Auxiliary Fire Latch

- FB32 Model with Auxiliary Fire Latch eliminates the bottom bolt and is UL Listed for Fire Doors.

FB33 Top Bolt with Auxiliary Fire Latch and Retrofit Plate

- FB33 Model with Auxiliary Fire Latch eliminates the bottom bolt and includes a retrofit plate to cover existing bottom bolt prep. UL Listed for Fire Doors.

Dimensions

Body Size: 1" Wide x 6-3/4" Long x 2" Deep
Guide Size: 1" Wide x 1-27/32" Long x 27/32" High x 3/32" Thick
Strike Size: 15/16" Wide x 2-1/4" Long x 1/16" Thick
Rub Plate Size: 1-1/4" Wide x 1-11/16" Long x 3/64" Thick
Auxiliary Fire Latch Size: 1" Wide x 1-3/4" Long x 3-1/4" Deep
Retrofit Plate Size: 1" Wide x 6-3/4" Long x 3/32" Thick

Finishes

Ives Number	US3	US4	US10	US10B	US32	US32D
BHMA	605	606	612	613	629	630

Meets ANSI/BHMA A156.16, L04251.
UL Listed 90 Minute Fire Doors 8'0" x 10'0"

FB458 Top or Bottom Bolts

- When the active door is opened, the lever can be moved to the 'up' position, retracting the bolt and allowing the inactive leaf to be opened. When the inactive leaf is closed, the lever can be moved to the 'down' position, projecting the bolt into the strike and securely locking the inactive leaf.
- Simplified installation in metal frames. Round bolt head requires only a punched hole. Use of strike optional. Special design of guide and flat sided bolt tip to prevent bolt rotation.
- Non-handed.
- Bolt tip is 1/2" diameter.
- Bolt throw is 3/4" with a 7/8" vertical adjustment.
- Bolt backset is 3/4"
- Standard Rod Length is 12", which is measured from the center of the flush bolt body to the bolt tip. Optional Rod Lengths available - 6", 9", 18" and 24" for fire rated Doors. Optional Rod lengths available - 6", 9", 18", 24", 30", 36" and 48" for non-fire rated doors.

DP1 or DP2 optional dust proof strike available, see page C11.

Dimensions

Body Size: 1" Wide x 6-3/4" Long x 1-1/8" Deep

Guide Size: 1" Wide x 2" Long x 5/64" Thick

Strike Size: 15/16" Wide x 2-1/4" Long x 5/64" Thick

Finishes

Ives Number	US3	US4	US5	US10	US10B	US15	US26	US26D
BHMA	605	606	609	612	613	619	625	626

COR

Series Bar Coodinators

- The COR Series Coordinators are designed for use on pairs of doors when one door needs to close before the other.
- All COR units function easily. The active door lever, located nearest to the active stop, holds the active door open until the trigger mechanism is released by the closing of the inactive leaf.
- All COR units may not function correctly with swingclear hinges.
- All COR units are equipped with an adjustable override feature which allows the active door to close under extreme pressure.
- All COR units are compatible with Flush Bolts.
- The COR Series is available in five sizes for variable door opening widths.
- The COR Series does not cover the entire length of the stop, so a FL filler bar can be provided to maintain architecturally clean lines.
- COR Series Coordinator Channels and FL fillers are made of aluminum.
- Optional Filler Bars: FL20 - 20", FL32 - 32" and FL44 - 44", available to maintain clean line.
- Optional Mounting Brackets available: MB1, MB2, MB1F, MB2F, MB3F, MB1V, MB2V, and MB3V for other stop applied hardware.

Meets ANSI/BHMA A156.3, Type 21A.
UL Listed for installation on labeled frame.

For Openings Where Doors Are Same Size

Coordinator Number	Length of Channel	For Opening Widths	Common Applications
COR32	32"	34" - 52"	Pair of 2'0" Doors
COR42	42"	52" - 72"	Pair of 2'6" Doors
COR52	52"	62" - 92"	Pair of 3'0" Doors
COR60	60"	70" - 108"	Pair of 3'6" Doors
COR72	72"	84" - 132"	Pair of 4'0" Doors

For Openings Where Doors Are Unequal Size

The coordinator length should equal the active door width plus approximately 1/2 the inactive door width. The coordinator must be 6" longer than the active door width and shorter than the overall frame opening between stops.

Finishes

Ives Finish	US28	US26D	315AN
BHMA	628	713	711

FL

Series Filler Bars

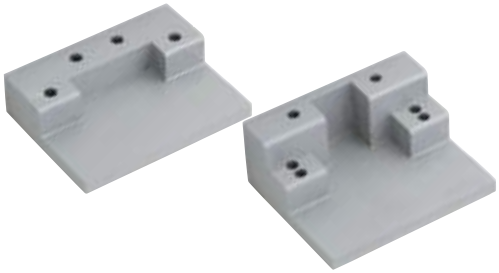
- The FL Filler Bars are available in three sizes for variable frame openings.
- FL Filler Bars are made of aluminum
- FL Filler Bars are field sized to frame opening.

Filler Bar Number	Length	Dimensions
FL20	20"	1-5/8" W x 5/8" D x 20" L
FL32	32"	1-5/8" W x 5/8" D x 32" L
FL44	44"	1-5/8" W x 5/8" D x 44" L

Finishes

Ives Finish	US28	US26D	315AN
BHMA	628	713	711

MB1and MB2



Mounting Brackets

- Allows stop mounted hardware to be properly installed without damaging the COR coordinator, such as a parallel arm closer or a non-fire-rated surface vertical rod strike.
- Stop mounted hardware will need to be lowered to compensate for the height of the coordinator and mounting bracket.
- MB mounting brackets are made of aluminum

Product	Jamb Depth	Stop Width	Dimensions
MB1	4-3/4" Min.	Over 2-1/2"	4" W x 3" D x 15/16" T
MB2	4-3/4" Min.	Up to 2-1/2"	4" W x 3-1/4" D x 1-5/8" T

Finishes

Ives Finish	USP	SP28	SPBLK
BHMA	600	689	622

MB1F, MB2F and MB3F
MB1V, MB2V and MB3V

MB1V

MB2V

MB3V

Fire Rated Mounting Brackets

- Allows for fire-rated stop mounted hardware to be properly installed without damaging the COR Coordinators, such as fire-rated surface vertical rod exit device strikes.
- Latch will need to be lowered to compensate for the height of the coordinator and mounting bracket.
- MB-V are designed for Von Duprin 8827-F soffit latch.
- Mounting brackets are made of steel.

Product	Jamb Depth	Stop Width	Dimensions
MB1F	5"	1-1/2" - 2-1/4"	4" W x 3" D x 1-5/8" T
MB1V	5"	1-1/2" - 2-1/4"	4" W x 3" D x 1-5/8" T
MB2F	5-7/8"	2-3/8" - 3-1/4"	4"W x 4" D x 1-5/8"T
MB2V	5-7/8"	2-3/8" - 3-1/4"	4"W x 4" D x 1-5/8"T
MB3F	6-7/8"	Over 3-3/8"	4"W x 3-1/2" D x 1"T
MB3V	6-7/8"	Over 3-3/8"	4"W x 3-1/2" D x 1"T

Finishes

Ives Finish	USP	SP28	SPBLK
BHMA	600	689	622

How to Order COR and Accessories

COR 52 US28 FL20 D 36"

COR Size:
32, 42, 52, 60, 72

Finishes:
US28, US26D, 315AN

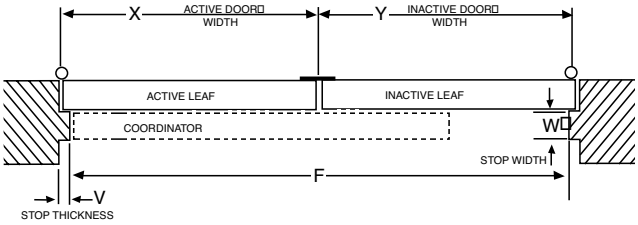
Filler Bar (if desired):
FL20, FL32, FL44

Vertical Rod Exit Device Cutout Type (if applicable):
A, B, C, D, E, F, G
If other Vertical Rod Exit Device not listed on chart, from page C16, include information as shown on page C16.

Active Door Size – Required for ALL Vertical Rod Exit Device Applications

To determine the size COR you need:

1. Start with the active door width (X).
2. Next consider the overall frame opening between stops (F).
3. Preferably, the coordinator would equal the active door width (X) + approximately 1/2 inactive door width (Y). The coordinator must be 6" longer than the active door width (X) and less than the overall frame opening between stop (F).



Examples:

- Pair of 30" Doors, 5/8" Stops
  Active Door Size, X = 30"
  Overall Frame Opening between Stops, F = 58-3/4"
  Recommended Coordinator: COR42

- Pair of 36" Doors, 5/8" Stops
  Active Door Size, X = 36"
  Overall Frame Opening between Stops, F = 70-3/4"
  Recommended Coordinator: COR52

- 36" Active Door, 18" Inactive door, 5/8" Stops
  Active Door Size, X = 36"
  Overall Frame Opening between Stops, F = 52-3/4"
  Recommended Coordinator: COR42

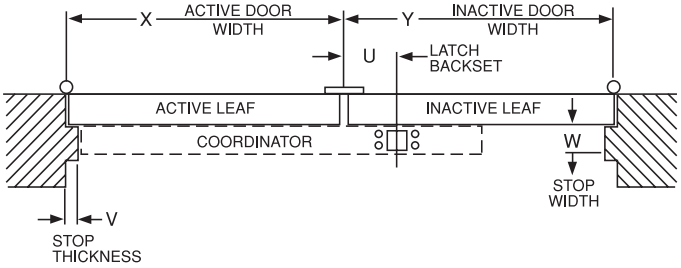
- 48" Active Door, 24" Inactive Door, 5/8" Stops
  Active Door Size, X = 48"
  Overall Frame Opening between Stops, F = 94-3/4"
  Recommended Coordinator: COR60

Special Factory Preparation for Use with Vertical Rod Exit Devices

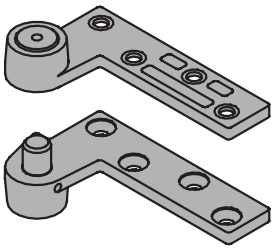
Coordinators may need to be prepared at the factory for use with some surface or concealed vertical rod exit devices. (See Chart below)

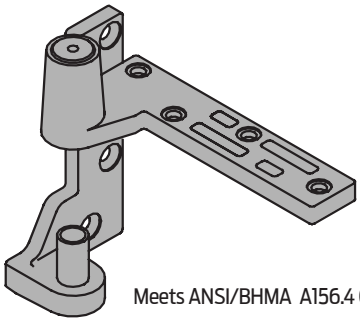
If the exit device is not listed the following information is needed.

1. Exit Device Manufacturer and Model No.
2. Active Door Size, "X"
3. Inactive Door Size, "Y"
4. Exit Device Backset, "U"
5. Stop Width, "W"
6. Stop Thickness if other than 5/8", "V"



Exit Device Manufacturer	Exit Device Number	Device Backset	Maximum Active Door	Coordinator Size Needed	Coordinator Cutout Type	Mounting Bracket Needed
Von Duprin	5547-F	2-3/8"	33" 43" 51" 63"	42" 52" 60" 72"	Type A	None
Von Duprin	8827-F	2-3/4"	33" 43" 51" 63"	42" 52" 60" 72"	Type B	MB1V, MB2V or MB3V *see page C3*
Von Duprin	8847-F	2-3/8"	33" 43" 51" 63"	42" 52" 60" 72"	Type C	None
Von Duprin	33/3547 33/3547-F 98/9947 98/9947-F	2-3/4"	33" 43" 51" 64"	42" 52" 60" 72"	Type D	None
Von Duprin	33/3548 33/3548-F 98/9948 98/9948-F	2-3/4"	33" 43" 51" 64"	42" 52" 60" 72"	Type D	None
Von Duprin	33/3547WDC 33/3547WDC-F 98/9947WDC 98/9947WDC-F	1-5/16"	34" 44" 52" 65"	42" 52" 60" 72"	Type E	None
Falcon	17-C F-17-C 18-C F-18-C XX-C F-XX-C 24-C F-24-C 25-C F-25-C	2-3/4"	33" 43" 51" 63"	42" 52" 60" 72"	Type F	None
Falcon	17-C-WDC F-17-C-WDC 18-C-WDC F-18-C-WDC XX-C-WDC F-XX-C-WDC 24-C-WDC F-24-C-WDC 25-C-WDC F-25-C-WDC	2-13/16"	33" 43" 51" 63"	42" 52" 60" 72"	Type G	None





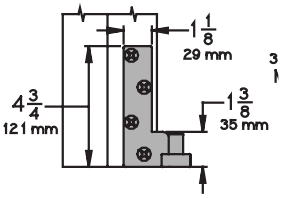
Meets ANSI/BHMA A156.4 C07131

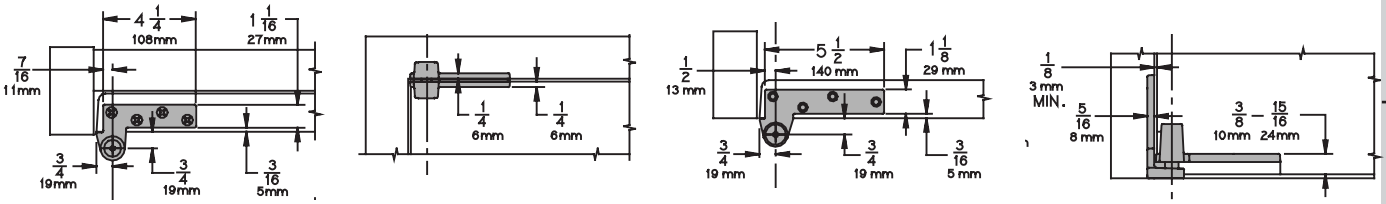
7215
7215F 3/4" Offset Pivot

- Handed
- Top, header mount
- Bottom, jamb mount
- Use with 1-3/4" minimum door thickness, with 1/8" bevel in 2"
- Maximum door load 500 pounds
- Vertical adjustment range 3/16", with positive locking
- WP - optional weather resistant bottom pivot is modified for improved corrosion resistance. Available in US26D (626) or US32D (630) only.

Optional 7215-7226-7227 or 7215F-7226F-7227F Intermediate Pivot (handed) for each additional 100 pounds or doors over 7'. See page A47.
Optional 7215PT Power Transfer, non-load bearing. See page A49

7215 - Ul Listed 20 minute fire doors
7215F - UL Listed 3 hour fire doors





7215

Plated Finishes *brass*

US Number	US3	US4	US10	US10B	US26	US26D
BHMA Number	605	606	612	613	625	626

Painted Finishes *brass*

US Number	SP4	SP10	SP28	SP313	SPBLK
BHMA Number	706	691	689	695	622

7215F

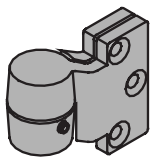
Plated Finishes *steel*

US Number	US3	US10	US32	US32D
BHMA Number	632	639	629	630

Painted Finishes *steel*

US Number	SP4	SP10	SP28	SP313	SPBLK
BHMA Number	706	691	689	695	622

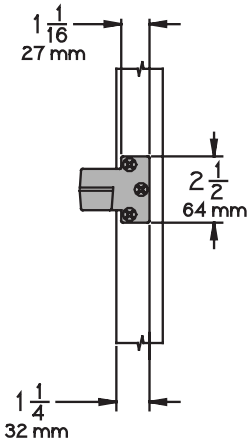
NFPA 80, Section 3-3.8 requires intermediate pivot on some fire door applications, consult factory. Use for door heights over 7'0" and one every 2'6" or . Use for door weight over the pivot set limit. One additional for every additional 100 pounds. Door thickness 1-3/4" mimumum with 1/8" bevel in 2".

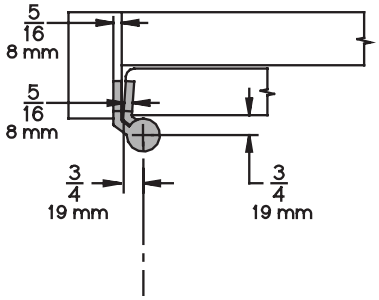


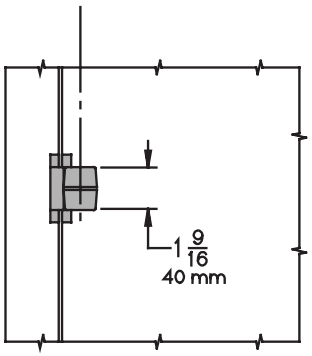
Meets ANSI/BHMA A156.4 C07382

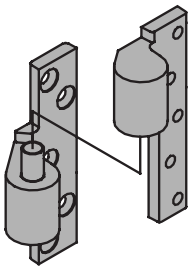
7212-7212V-7222 INT

- Use with 7212, 7212V or 7222 3/4 Offset Pivot
- Handed
- Vertical adjustment 3/16", include positive locking.









7215-7226-7227 INT:
UL listed 20 minute fire doors
Meets ANSI/BHMA A156.4 C07321

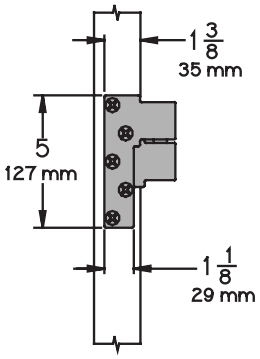
7215-7226-7227 INT

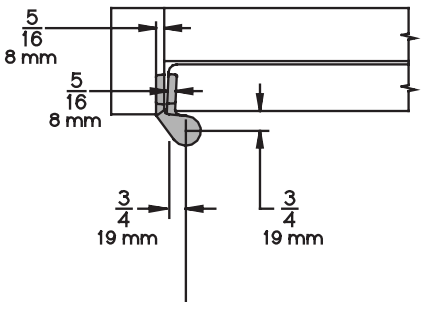
- Use with 7215, 7226 or 7227 3/4 Offset Pivot
- Handed
- Vertical adjustment 3/16", include positive locking.

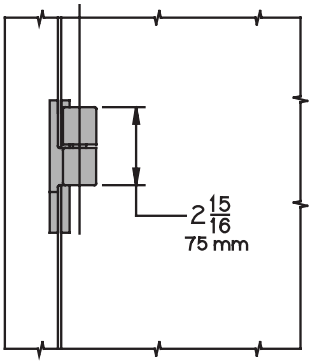
7215F-7226F-7227F INT:
UL listed 3 hour fire doors
Meets ANSI/BHMA A156.4 C07371

7215F-7226F-7227F INT

- Use with 7215F, 7226F or 7227F 3/4 Offset Pivot
- Handed
- Vertical adjustment 3/16", include positive locking.







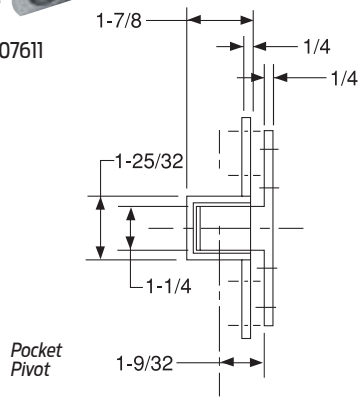
UL Listed 3 hour fire doors
or 20 minute wood fire doors

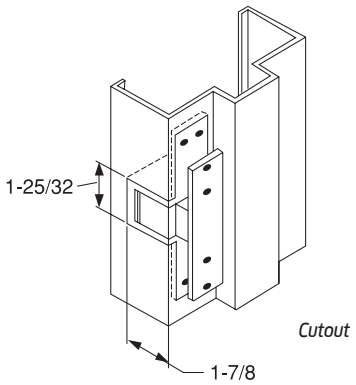
Meets ANSI/BHMA A156.4 C07611

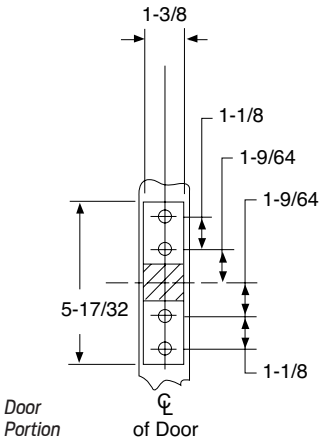
91105F, 91105F-PT Pocket Pivot/Hinge

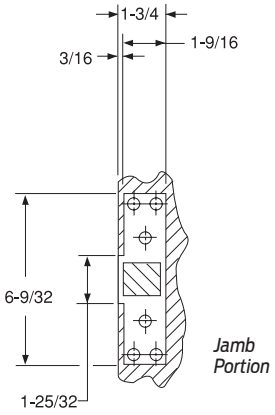
- Non-handed
- All stainless steel construction.
- Allows door to open a full 90 (* degree mark)
- Full mortise
- 90 pound load bearing
- Use two for doors up to 7'0" and over 7'0" use three.
- PT, Power Transfer version has four 28 gauge wires (contact factory for eight wire version). Rated 50 VOC or VAC @ 3.5 amps. Continuous or 16 amps pulse. Maximum pulse 400 milliseconds.

91105F Pocket Pivot









Plated Finishes *steel*

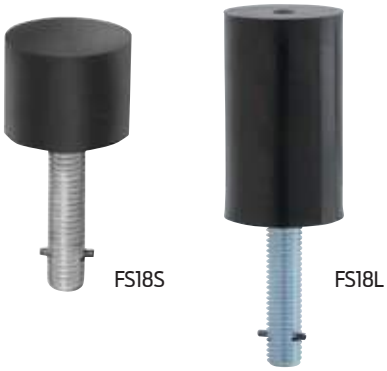
US Number	US3	US10	US10B
BHMA Number	632	639	640

Painted Finishes *steel*

US Number	USP	SP313
BHMA Number	600	695

Finishes *stainless steel*

US Number	US32	US32D
BHMA Number	629	630



FS18S
FS18L Floor Stops

- Security Door Stops designed for use in high vandalism areas.
- Molded from black flame resistant, resilient material around a heavy-duty stud.
- Once grouted in concrete, leaves no exposed fasteners to be tampered with or removed.
- Ideal for jail or security cell areas where floor mounted stops are required.
- FS18L also ideal for concrete wall applications.

Dimensions

FS18S Height: 1-1/2"
FS18S Diameter: 2"
FS18S Stud Length: 2-1/2"

FS18L Height: 3-1/2"
FS18L Diameter: 2"
FS18L Stud Length: 2-1/2"

FS434 Floor Stop

- Burnished wrought steel.
- For undercut doors up to 1-1/2".
- Packed with screws and plastic anchors.
- Replaceable soft, resilient gray rubber.

Dimensions

Overall Height: 2-5/8"
Base Size: 1-1/2" W x 2-3/4" L

Finishes

Ives Number	USC
BHMA	604

430 Floor Door Stop

- Burnished wrought steel.
- For undercut doors up to 1-1/2".
- Packed with screws and plastic anchors.
- Replaceable soft, resilient gray rubber.

Dimensions

Overall Height: 1-5/16"
Base Diameter: 1-1/4"

Finishes *brass*

Ives Number	B3	B4	B5	B10B	B15	B26	B26D
BHMA	605	606	609	613	619	625	626

Finishes *aluminum*

Ives Number	A3*	A5	A14	A92
BHMA	666		669	673

** only available in Slim-Pak of 25*

WS401CCV & WS402CCV
Meets ANSI/BHMA 156.16 L12251 for brass

WS401CVX & WS402CVX
Meets ANSI/BHMA 156.16 L12101 for brass

WS401CVX Wall Bumpers
WS401CCV
WS402CVX
WS402CCV

- Constructed in heavy-duty cast brass.
- Special retainer cup makes rubber tamper resistant.

WS401CVX (401) – convex rubber bumper, packed with wood screw and plastic anchor.
WS401CCV (401-1/2) – concave rubber bumper which avoids damage to locks with projecting buttons, packed with wood screw and plastic anchor.
WS402CVX (402) – convex rubber bumper packed with screw and drywall anchor.
WS402CCV (402-1/2) – concave rubber bumper which avoids damage to locks with projecting buttons and is packed with screw and drywall anchor.

Dimensions

Base Diameter: 2-1/2"

Base Thickness: 3/8"

Overall Projection: 1"

Finishes

Ives Number	US3	US4	US10	US10B	US15	US26	US26D
BHMA	605	606	612	613	619	625	626

WS404CVX Wall Bumpers

- Compact size.
- Constructed in cast brass.
- Totally concealed mounting discourages vandalism or tampering.
- Unit furnished with grey convex rubber bumper.
- Packed with sheet metal screw, rawl plug and brad.

Dimensions

Base Diameter: 1"

Overall Projection: 17/32"

Finishes

Ives Number	US3	US4	US5	US10	US10B	US15	US26	US26D
BHMA	605	606	609	612	613	619	625	626

Meets ANSI/BHMA 156.16, L11291 for brass and L31291 for aluminum.

WS40 Automatic Wall Holder

- Constructed of sturdy cast brass, or aluminum.
- Holder is mounted on wall and strike is mounted on door.
- Roller on holder rides up seats itself on strike, with a heavy duty bumper pad deadening the sound and shock.
- Universal screw pack accommodates all types wall construction.

Dimensions

Base Height: 2”
Base Width: 2-1/2”
Base Projection: 2-1/4”
Engaged Projection: 3-1/2”

Strike Height: 2-1/16”
Strike Width: 3/4”
Strike Projection: 2”

Finishes *brass*

Ives Number	US3	US4	US10	US10B	US26	US26D
BHMA	605	606	612	613	625	626

Finishes *aluminum*

Ives Number	US28
BHMA	628

WS45
Meets ANSI/BHMA 156.16, L11291 for brass and L31291 for aluminum.

WS45
WS45X Automatic Wall Holder

- Constructed of cast brass, bronze or aluminum.
- Spring loaded roller rides up the face of the strike, seating itself on the strike, holding the door firmly in the open position.
- A heavy rubber pad cushions the shock and absorbs the sound.
- With unit mounted on door and the strike on wall, vertical adjustment is available on body.
- The strike is adjustable 45 degrees left or right, both adjustments easily accomplished at time of installation or at a later date.

WS45 strike is furnished with wood screws for drywall mounting.

WS45X strike is furnished with a threaded stud and expansion shield for masonry type mounting.

Dimensions

Base Height: 3-11/16”
Base Width: 3”
Base Projection: 2”
Engaged Projection: 3-7/16”

Strike Diameter: 2-3/8
Strike Projection: 3”

Finishes *brass*

Ives Number	US3	US4	US10	US10B	US26	US26D
BHMA	605	606	612	613	625	626

Finishes *aluminum*

Ives Number	US28
BHMA	628

Meets ANSI/BHMA 156.16, L03011.

SR64 Door Silencer

- For use on metal frames featuring pneumatic design that, once installed, forms an air pocket to absorb shock and reduce noise of door closing.
- Tamper-proof once installed on the frame.
- Proper installation also eliminates door rattle and provides constant tension for door latches or locks.

Packed in bags of 100.
Grey Available in bulk pack of 2500.
Each bag has an installation tool included.

Dimensions

Diameter: 1/2”

Thickness: 1/8”

Finishes

GRY, TAN

Meets ANSI/BHMA 156.16, L03021

SR65 Door Silencer

- For use on wood frames, also feature pneumatic design to cushion shock and absorb noise.
- To prevent removal, a small brad should be driven into stop strip and through stem of silencer, as shown in the detail.

Packed in bags of 100.

Dimensions

Height: 3/4”

Diameter: 3/8”

Thickness: 1/8”

Finishes

GRY

SR66 Door Silencer

- Self Adhesive Rubber Silencers.
- Economical installation requires no drilling of frames.

Packed two sheets of 50 (100 minimum).

Dimensions

Diameter: 1/2”

Thickness: 1/8”

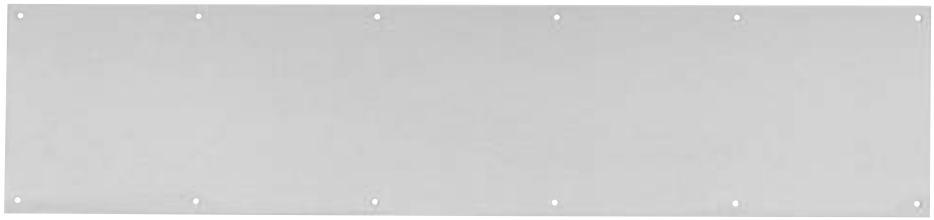
Finishes

BRN, GRY, WHT

8400 Series Protection Plates

- Door protection plates are available in .050" thick brass, stainless steel or aluminum; and 1/8" thick high impact polyethylene in clear or black.
- Bevel edge options; specify B4E for all four edges.
- Mounting screw pack furnished standard, 16 screws per pack. Optional screw packs are available for TEK or TORK screw heads. Refer to the following chart for ordering.
- Specify NMH for no mounting holes. (Not available on 8402)
- Specify NMH-A for no mounting holes with adhesive. (Not available on 8402)
- Specify CS for counter sunk mounting holes.
- Specify ERS prepped with extra row of screws.

Kickplate Gasket Tape Tape is recommended when using a brass plate on a metal door to reduce tarnishing from electrolytic oxidation. One tape pack will cover an the perimeters of a 8" x 34" kickplate. Order 8401 Gasket Tape.



8400 Protection Plate
8402 (UL)* Protection Plate

**UL mark appears in upper right corner. Factory supplied screws must be used.*

Number of screw packs required by plate size (specify TEK Screws or TORK screws).

	22"-25"	26"-33"	34"-41"	42"-48"
4"-8"	1	1	1	1
9"-16"	1	1	1	1
17"-24"	1	1	1	2
25"-32"	1	1	2	2
33"-40"	1	2	2	2
41"-48"	2	2	2	2

Finishes *brass 24" x 48" max. size*

US Number	US3	US4	US10	US10B	US15	US26	US26D
BHMA	605	606	612	613	619	625	626

Finishes *stainless steel*

US Number	US32	US32D
BHMA	629	630

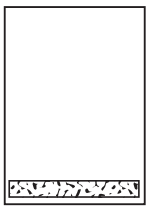
Finishes *aluminum*

US Number	US28
BHMA	628

Finishes *plastic*

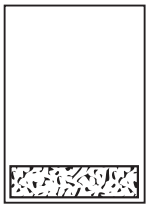
Clear and Black

Residential Grade Kickplates available Carded only, finishes PA28, PA3, PA619, PA716, B3, B505, B619, B716



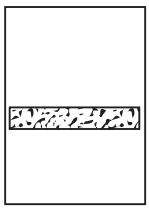
Mop Plates

- Protect the bottom of the pull side of door subject to cleaning and mopping procedures.
- Size Ranges:4" to 6" high, 22" to 48" wide



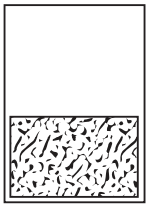
Kick Plates

- Protect the bottom of the push side of doors subject to scuffing from foot traffic.
- Recommended for all doors subject to normal use (especially doors using a closer).
- Size Ranges: 8" to 24" high, 22" to 48" wide



Stretcher Plates

- Protect doors at specific areas where consistent contact is made by stretchers, service carts or other equipment.
- Usually applied to push side of doors.
- Specify "B4E" Option for beveled edges.
- Size Ranges: 6" to 8" high, 22" to 48" wide



Armor Plates

- Protect lower half of doors from abuse by hard carts, trucks and rough usage.
- Usually applied to push side of single doors and both sides of double acting doors.
- Size Ranges: 26" to 48" high, 22" to 48" wide

Meets ANSI/BHMA A156.1
A8133 – Steel
A5133 – Stainless Steel
A2133 – Brass

5PB1 5 Knuckle, Plain Bearing Full Mortise Hinge

- For standard weight doors
- Low frequency usage
- Packed with wood and metal screws

Not for use with a door closer.

Options

- NRP, Non-Removable Pin
- SH, Security Stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

Size (Inches)	Size (mm)	Gauge
3.5 x 3.5	89 x 89	0.123
4 x 4	102 x 102	0.134
4.5 x 4	114 x 102	0.134
4.5 x 4.5	114 x 114	0.134
5 x 4.5	127 x 114	0.134

Meets ANSI/BHMA A156.1
A8112 – Steel
A5112 – Stainless Steel
A2112 – Brass

5BB1 5 Knuckle, Ball Bearing Full Mortise Hinge

- For standard weight doors
- Medium frequency usage
- 2 ball bearing
- Packed with wood and metal screws

Options

- NRP, Non-Removable Pin
- SH, Security Stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

Size (Inches)	Size (mm)	Gauge	Size (Inches)	Size (mm)	Gauge
3.5 x 3.5	80 x 102	0.130	5 x 4.5	127 x 114	0.146
4 x 4	102 x 102	0.130	5 x 5	127 x 127	0.146
4.5 x 4	114 x 102	0.134			
4.5 x 4.5	114 x 114	0.134			

Finishes *brass*

Ives Finish	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	605	606	612	613	614	616	619	625	626

Finishes *steel*

Ives Finish	USP	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	600	632	633	639	640	641	643	646	651	652

Finishes *stainless steel*

Ives Finish	US32	US32D
BHMA	629	630

Meets ANSI/BHMA A156.1
A8111 – Steel
A5111 – Stainless Steel
A2111 – Brass

5BB1HW 5 Knuckle, Ball Bearing, Heavy Weight Full Mortise Hinge

- For heavy weight doors
- High frequency usage
- 4 ball bearing
- Packed with wood and metal screws

Options

- NRP, Non-Removable Pin
- SH, Security Stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

Size (Inches)	Size (mm)	Gauge	Size (Inches)	Size (mm)	Gauge
4.5 x 4	114 x 102	0.180	5 x 4.5	127 x 114	0.190
4.5 x 4.5	114 x 114	0.180	5 x 5	127 x 127	0.190

Meets ANSI/BHMA A156.1
A8111 – Steel

5BB1WT 5 Knuckle, Ball Bearing, Wide Throw Full Mortise Hinge

- For medium weight doors
- Medium frequency usage
- 2 ball bearing
- Packed with wood and metal screws

Options

- NRP, Non-Removable Pin
- SH, Security Stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

Size (Inches)	Size (mm)	Gauge
4.5 x 5	114 x 127	0.134
4.5 x 6	114 x 152	0.134
5 x 6	127 x 152	0.146
5 x 7	127 x 178	0.146
5 x 8	127 x 203	0.146

Finishes *brass*

Ives Finish	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	605	606	612	613	614	616	619	625	626

Finishes *steel*

Ives Finish	USP	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	600	632	633	639	640	641	643	646	651	652

Finishes *stainless steel*

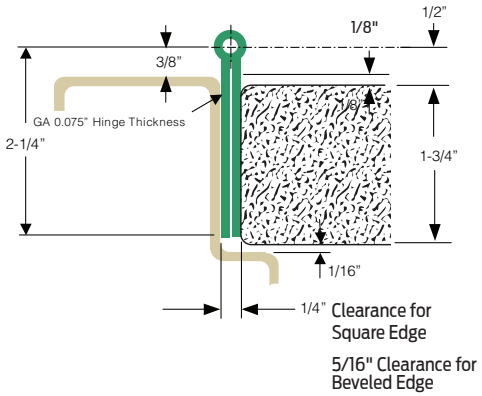
Ives Finish	US32	US32D
BHMA	629	630

600
700 Full Mortise Pin and Barrel Continuous Hinge

For Doors Weighing up to 600 pounds
- Non Handed
- 1/8" Inset
- 48" Maximum Door Width
- Non Handed
- Bevel or Square Edge Door

Standard lengths 83", 85", 95", 120"
Standard Mounting Hardware
#10 X 1/2" Self Drilling Self Tapping Screws,
#10 X 1" Wood Screws
Optional SEC - Security Fasteners Available

Material
600- 1012 Cold-Rolled Steel
700- 14 Gauge Type 304 Stainless Steel
1/4" Diameter 304 Stainless Pin with
Nylon Split Bearing



Finishes	600	700
BHMA	600	630
US Numbers	USP	US32D

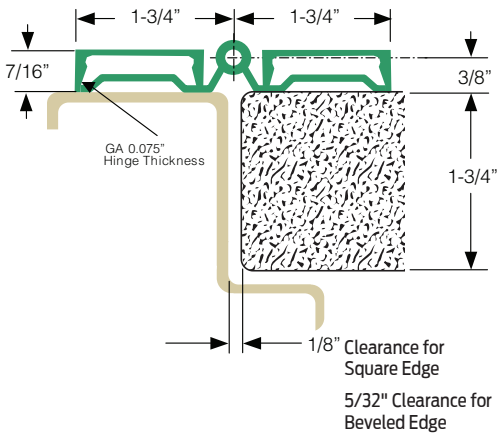
Custom Paint Available, on 600 consult factory.

602
702 Full Surface Pin and Barrel Continuous Hinge

For Doors Weighing up to 600 pounds
- Non Handed
- Flush Mounted, No Inset
- 48" Maximum Door Width
- Bevel or Square Edge Door

Standard lengths 83", 85", 95", 120"
Standard Mounting Hardware
1/4"-20 x 3/4" Self Drilling Self Tapping Screws,
Cover Clips
Optional SEC - Security Fasteners Available

Material
602- 1012 Cold-Rolled Steel
702 - 14 Gauge Type 304 Stainless Steel
1/4" Diameter 304 Stainless Pin with
Nylon Split Bearing
Brushed Aluminum Leaf Covers



Finishes	602	702
BHMA	600	630
US Numbers	USP	US32D

Custom Paint Available, on 602 consult factory

Long Door Pulls

Offered in two Models:

9264 Offset
9266 Straight

- Heavy 1-1/4" Round Brass or Stainless Steel
- Round or Flat Tip
- 316 Stainless Steel
- 1-3/4″, 2″ or 2-1/4″ Door Thickness
- Round Tip Standard
- Flat Tip Optional

Dimensions

Length: 36" / 20" CC
72" / 56" CC
Diameter: 1-1/4"
Projection: 2-3/4"

Special Lengths Available

18" and 24"
Custom lengths available from 36" to 144"

Finishes

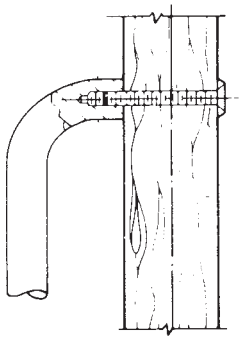
Ives Number	US3	US4	US10B	US32	US32D
BHMA	605	606	613	629	630

Note: A middle position bracket is required for pulls over 8 feet.

Mounting

- All mounting hardware is for standard 1-3/4" door.
- Consult Customer Service if other than standard.

Type Standard Mount

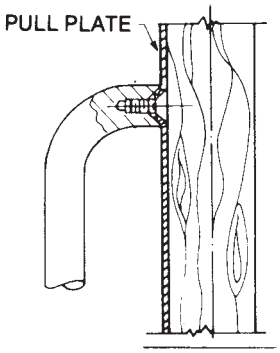


Standard Mounting

- (2) 3/8-16 x 2-1/4" brass, flat head machine screws; plate to match.
- (2) 3/8-16 countersunk washers; plated to match

Note: 8102HD and 8105 have (2) 5/16-18 x 2-1/2" machine screws
-Options: (2) 5/16 countersunk washers

Type G Mount



Concealed Pull Plate Mounting

Available only for 8302, 8303, 8311 Pull Plates.

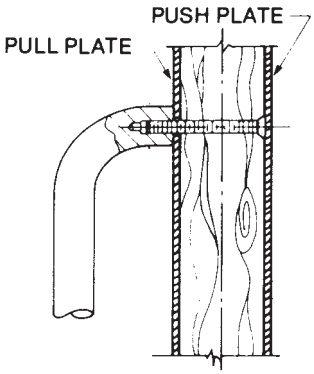
- (2) 3/8-16 x 5/8" steel flat head machine screws; zinc plated.

Pull mounts directly onto plate.

Plate is attached to door by 6 screws.

Note: 8302 has (2) 5/16-19 x 5/8" steel flathead zinc plated screws

Type F Mount



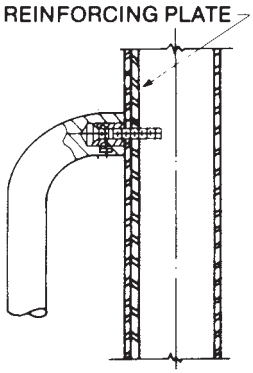
Wood Doors
Concealed Pull Mounting With Push Plate

- (2) 2-1/4" steel flat head machine screws; zinc plated.

Available only for 8102HD, 8103HD, 8105, 8111, 8302, 8303, 8305 and 8311. Plate on opposite side of door must be ordered separately.

Note: 8102HD, 8302 will have 5/16-18
8105, 8111, 8305, 8311 will have 1/4-20
8103HD, 8303 will have 3/8-16"

Type H-I-L Mount



Reinforced Hollow Metal Door
Concealed Pull Mounting

Available only for 8102, 8103, 810EZ or wood door pulls, 8302, 8303 pull plates and 9264, 9265, 9266 and 9267 long door pulls.

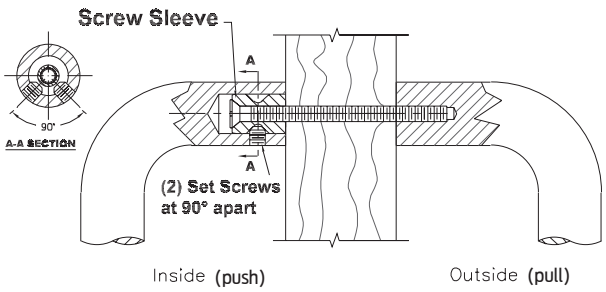
- (2) Steel screw sleeves; zinc plated.
- (2) Steel countersunk trim head machine screw; zinc plated for reinforced metal door.
- (2) Steel countersunk trim head steel metal screw; zinc plated for wood doors.

Note: 8102HD and 8302 will have 5/16-18"
8103HD, 8103EZHD, 8303 will have 3/8-16

Mounting for 8103EZ, 8190, 9100, 9103EZ, 9190 and 9264, 9265, 9266 and 9267 long door pulls.

- All mounting hardware is for standard 1-3/4" door.
- Consult Customer Service if other than standard.

Type J/N Mount



Back to Back "Two-Anchor"

Wood or Metal Door

Available only for 8103EZHD, 8190HD, 9100HD push/pull combinations and 9264, 9265, 9266 and 9267 long door pulls.

- (2) 3/8-16 x 2-3/4" steel countersunk trim head machine screws with (4) set screws for maximum anchoring force.
- (2) Steel screw sleeves; zinc plated.

Type NS-Standard Push/Pull Mounting

Type N & Standard

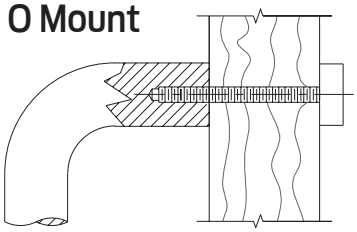
Pushbar to Pull

- (1) 3/8 - 16 X 3"steel countersunk trim head machine screws with (2) set screws.
- (1) steel screw sleeve, zinc plated.

Free End Pushbar & Pull

- (2) 3/8 - 16 X 2-1/4" brass, oval head mach screws; plated to match.
- (2) No. 14 countersunk washers; plated to match.

Type O Mount



Decorative Blind Thru - Bolt

Wood or Metal Door

Available only for 8103EZHD, 8190HD and 9100HD Series Push/Pull Combinations.

- (2) 3/8-16 x 2-1/4" blind thru - bolts; plated to match.

Type NO Push/Pull Mounting

Type N & Type O

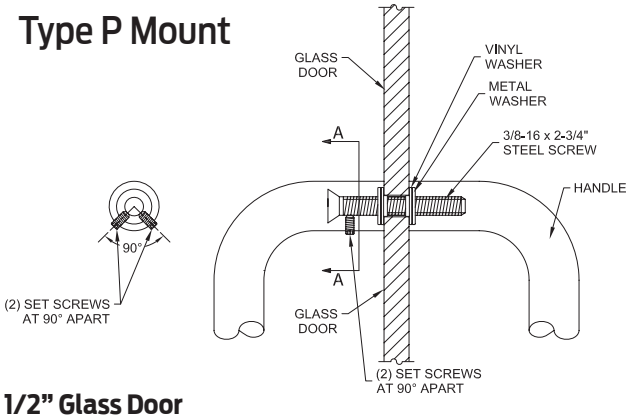
Pushbar to Pull

- (1) 3/8 -16 X 3"steel countersunk trim head machine screws with (2) set screws.
- (1) steel screw sleeve, zinc plated.

Free End Pushbar & Pull

- (2) 3/8 - 16 X 2-1/4" blind thru-bolts; plated to match.

Type P Mount



1/2" Glass Door

Available only for 8103EZHD, 8190HD, 9100HD, 9265 and 9266 long door pulls.

- (2) 3/8-16 x 2-1/4" steel countersunk trim head machine screws with (4) set screws for maximum anchoring force.
- (2) Steel screw sleeves; zinc plated
- (2) Metal and Vinyl washers

FS439 Universal Dome Floor Stop

- High or Low-Rise Mount
- Zinc or Stainless Steel
- Spring-loaded Rubber Contact
- Replaceable Rubber Bumper

Dimensions

Overall Height: 1-1/2"
Pad Height: 1-1/8"
Base Height: 1/4"
Base Diameter: 1-7/8"

Finishes

Ives Number	US3	US4	US10B	US26D	US32D
BHMA	677	678	704	682	630

FS410 Decorative Floor Stop

- Non-directional
- Cast Brass Construction
- Replaceable Rubber Bumper

Dimensions

Overall Height: 1-1/2"
Bumper Thickness: 1/4"
Diameter: 1-1/4"

Finishes

Ives Number	US3	US26D
BHMA	605	626

224XY Full Mortise - Door Edge Protector

UL10C certified
Meets ANSI 156.26 for 150 lbs and 300 lbs.

- For 1 3/4" Doors
- Door Edge Protector
- Patented center loaded, interlocking bearing design
- Non Handed for custom cut lengths
- 1/16" door inset
- 48" Maximum Door Width
- Beveled or Square Edge Doors
- Frame guidance lip is extended further for retrofit applications to cover existing heavy weight architectural hinge preps
- For doors weighing up to 450 pounds without reinforcing, 600 pounds with reinforcing
- For lead-lined application consult factory for engineering specials

Standard lengths 83", 85", 95", 119"

Standard Mounting Hardware

12-24 x 3/4" Steel Self Drilling / Self Tapping Phillips Head Screw

Finishes

Clear Anodized (US28), Dark Bronze Anodized (313AN)
Custom Anodizing and Painting are available, consult factory

Options:

HT	Hospital Tip
EPT	Electric Power Transfer
TWP CON	Electrical Through Wire Panel with Allegion Connect

Optional Mounting Hardware:

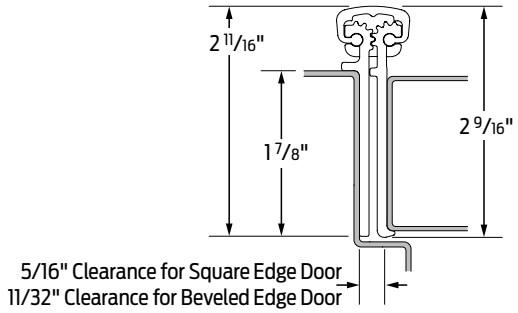
TEK/WD	1/2 Self Drill, Self Tap 1/2 Wood
WD	Wood Door and Frame

Available Accessory Kits:

Security Screws - Hollow Metal
Security Screws - Wood
Thread Forming Screws

For Single Door Applications

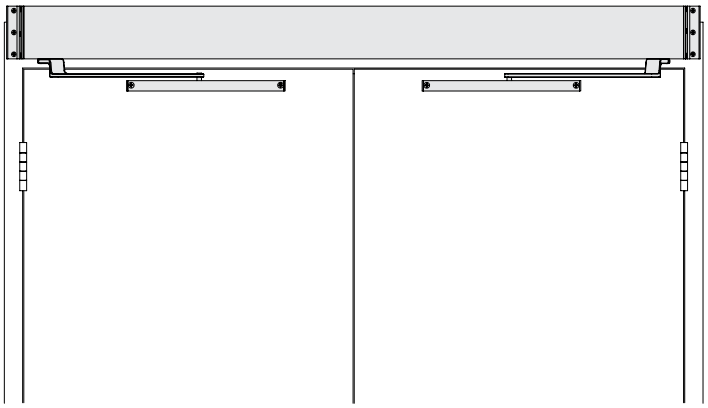
For pairs of doors see chart and general information



9550 SERIES

FEATURES

OPERATOR MOUNTS
SIMULTANEOUS PAIR, SURFACE MOUNT
***PULL SIDE**
PUSH SIDE
DOUBLE EGRESS



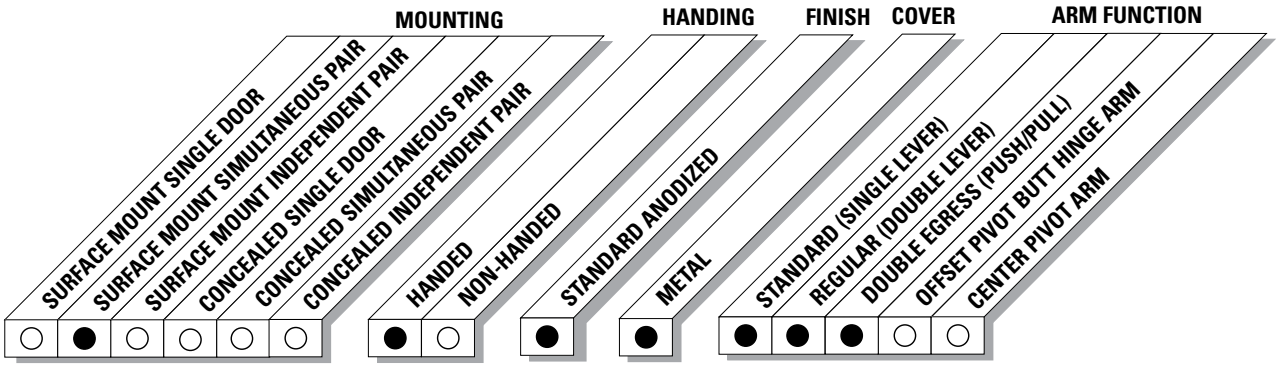
**PULL SIDE mount shown*

The 9550 SENIOR SWING by LCN is an ADA door operator that is a two-in-one swing door operator. SENIOR SWING operators when activated, opens doors automatically for wheelchair access, yet allows for manual operation for regular pedestrian traffic.

- Push 'N Go permits non-switch activation.
- Power Boost provides additional latching force.
- Electromechanical unit with microprocessor control.
- Digital keypad for easy setup.
- Meets International Building Code requirements and ANSI A156.19.
- UL approved for fire doors.

- 9550 Series operator is shipped with motor gearboxes, control box, arms, header, and mounting hardware. Actuators available separately, see pages 122-137.
- Simultaneous pair, surface mounted.
- Meets ADA requirements (power mode only).
- Handed product.
- Pull, Push or Double Egress applications available.
- 72″ header length is standard. Specify other length 52″ to 98″. Consult factory regarding this option.
- Adjustable hold open period of 2 to 32 seconds in automatic or manual mode.

9550 Series is fully compliant with UL 325 & UL 1998 and meets the provisions of ANSI A156.19. The 9550 Series is UL listed for fire-rated applications. The 9550 Series also meets the provisions of the Americans with Disabilities Act.



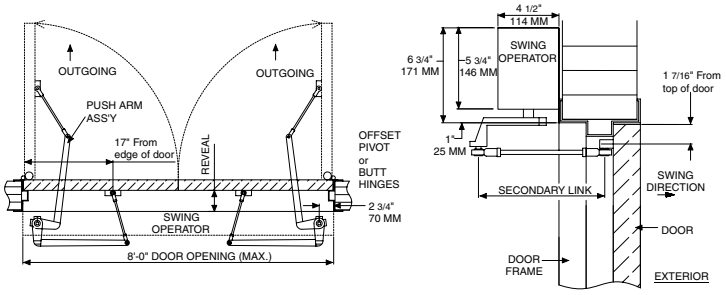
● AVAILABLE
○ NOT AVAILABLE

PHONE 877-671-7011
FAX 800-248-1460
www.allegion.com/us
2/14

LCN 9550 SERIES

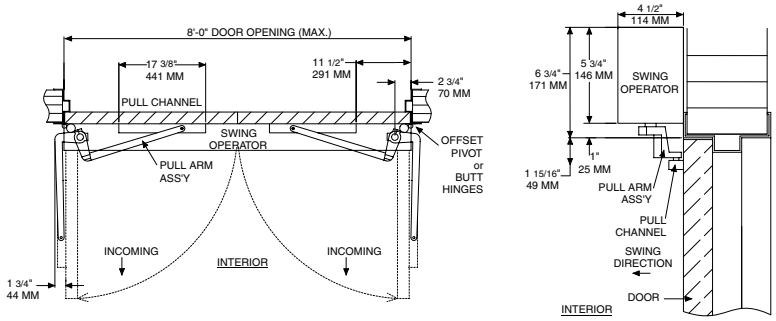
TOP JAMB SIMULTANEOUS PAIR (OFFSET PIVOT/BUTT HINGE, CENTER PIVOT, PUSH) MOUNTING

Consult factory for all balanced door installations.



TOP JAMB SIMULTANEOUS PAIR (OFFSET PIVOT/ BUTT HINGE, CENTER PIVOT, PULL) MOUNTING

NOTE: Cannot be used with swing clear hinges, pocket pivots or balanced doors.



MAXIMUM OPENING

Template allows 90 degree power opening and 90 degree manual opening.

- **Butt Hinges** should not exceed 5″ (127 mm) in width.
- **Reveal for push** installations should not exceed 10″ (254 mm) for REGULAR ARM and 20″ (508 mm) for LONG ARM.
- **Reveal for pull** installations should not exceed 4″ (102 mm).
- **Reveal** for double egress installations should not exceed 4″ (102 mm).
- **Head Frame** minimum 1-3/4″ (44 mm). Face frame 6-3/4″ (171 mm) total operator clearance.
- **Top Rail** minimum 2-3/4″ (70 mm).
- **Opening & Closing Time** are variable by adjustments to the electronic control box. Maximum hold open time adjustable up to approximately 32 seconds.
- **System Diagram** see "AUTOMATIC OPERATORS" section pages 53 for typical system wiring and page 56 for electrical data.

Contact LCN Product Support for installation assistance.

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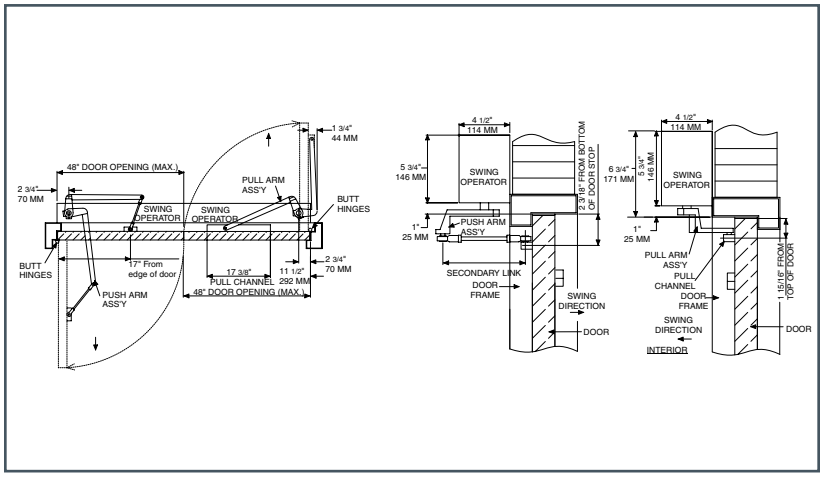

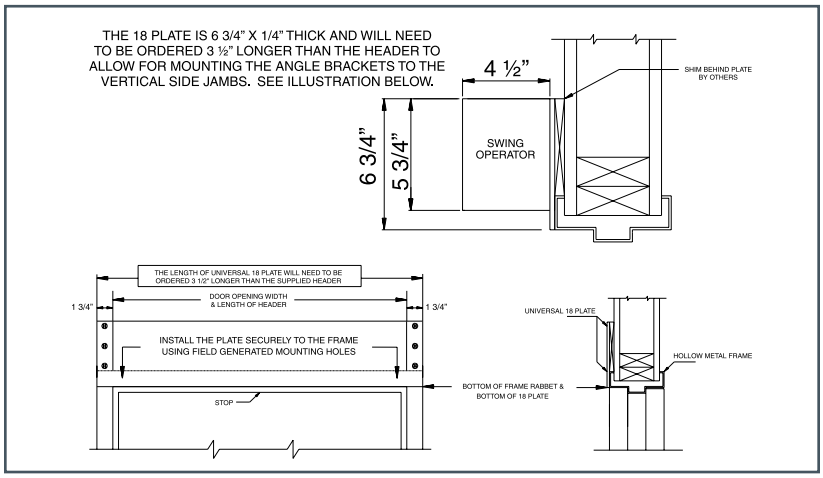

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- **System Diagram** see "AUTOMATIC OPERATORS" section pages 53 for typical system wiring and page 56 for electrical data.

TOP JAMB SIMULTANEOUS PAIR (RH DOUBLE EGRESS) MOUNTING

Double egress applications with safety sensors require LCN 9560 series.

NOTE: Cannot be used with swing clear hinges, pocket pivots or balanced door.

HOLLOW METAL FRAME

Suggested Installation.

MAXIMUM OPENING

Template allows 90 degree power opening and 90 degree manual opening.

Contact LCN Product Support for installation assistance.

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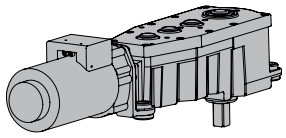
9550 SERIES

MOTOR GEARBOX

MOTOR GEARBOX – SENIOR SWING, 9550-3454
Driving mechanism for operator. Provides 15 lbs opening force. Handed.

3454



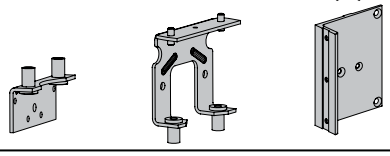
MOUNTING BRACKETS

MOUNTING BRACKET – 2-3/4˝, 9550-275
Motor gearbox mounting bracket for 2-3/4˝ offset pivot or butt hinge installations. Front bracket.

REAR MOUNT BRACKET, 9550-3018
Motor gearbox mounting bracket. Rear bracket.

ANGLED BRACKET, 9550-334-1
Mounting bracket for surface applications. (Includes 2 mounting brackets).

275 3018 334-1 (2)

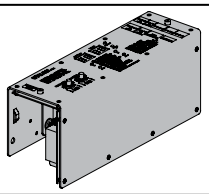


CONTROL BOXES

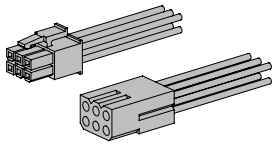
CONTROL BOX – SENIOR SWING, 9550-3462
Electronic controlling device for Senior Swing.

COMPANION CABLE, 9550-982
Cable that allows one control box to run two motor gear boxes. Companion cable. For use with Senior Swing.

3462



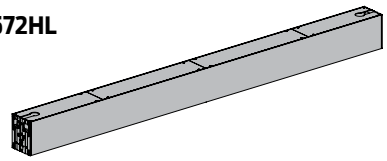
982



HEADERS

HEADER, 9550-3572HL
Standard, mounting header. Pair door, two operators. Specify length 52˝ to 98˝ maximum.

3572HL

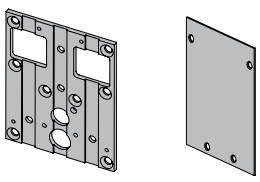


END CAPS

HEADER ENDCAPS, 9550-334
End cap with openings for wiring.

END DRESS PLATE, 9550-334-2
Metal finish end cap.

334 334-2



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ARMS

STANDARD ARM ASSEMBLY, 9550-3077PLCM
Handed arm. (Includes 3077 regular arm assembly, 3038 track, and 3034 track roller).

REGULAR ARM ASSEMBLY, 9550-3077
Handed arm. (Includes 77 main arm assembly and 79 linkage assembly).

REGULAR LONG ARM ASSEMBLY, 9550-3077L
Handed arm. (Includes 77 main arm assembly and 79LR linkage assembly).

STANDARD ARM, 9550-3077T
Handed arm. Track roller not included.

MAIN ARM, 9550-77
Handed arm attaches to motor gearbox.

LINKAGE ASSEMBLY – 15″, 9550-79
Threaded rod attaches to door. Extends from main arm.

LINKAGE ASSEMBLY – 32″, 9550-79LR
Threaded long rod attaches to door. Extends from main arm. Used for reveal 10″ to 20″.

TRACKS

TRACK 9550-3038
Standard non-handed track.

TRACK END CAP 9550-73
Black plastic end caps.

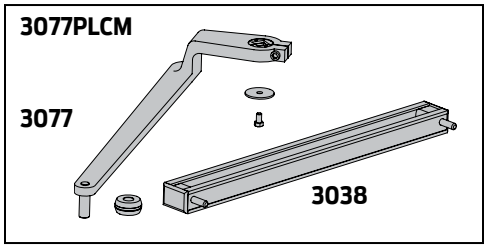
ROLLER, 9550-3034
Quiet low friction roller assembly.

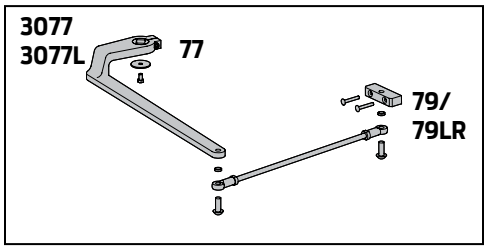
INSTALLATION ACCESSORIES

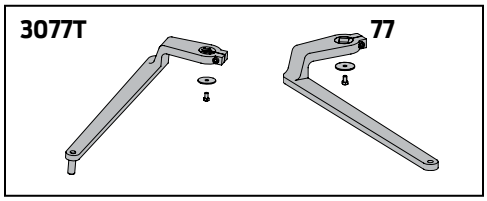
SPINDLE PLATE – 2-3/4″, 9550-11A
Hides bottom of motor gearbox. Completes header box. Cutout allows for motor gearbox shaft. For 2-3/4″ offset pivot or butt hinge installations.

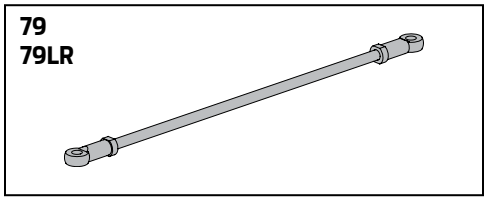
FILLER PLATE BLANK, 9550-12
Completes length of header box. (Specify length).

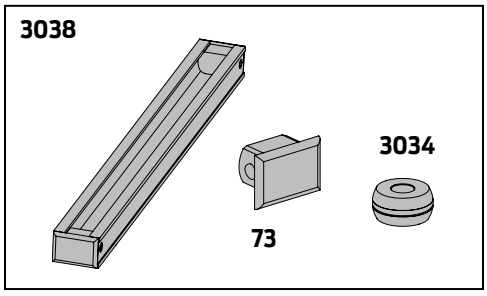
MOUNTING PLATE, 9550-18
Optional mounting plate for standard hollow metal door frames. Specify length 55-1/2″ to 101-1/2″ maximum when using angle brackets. Specify length 52″ to 98″ maximum when using dress plates.
NOTE: The length of a universal 18 plate will need to be ordered 3-1/2″ longer than the supplied header when using angle brackets.

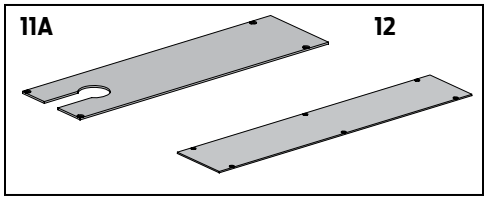


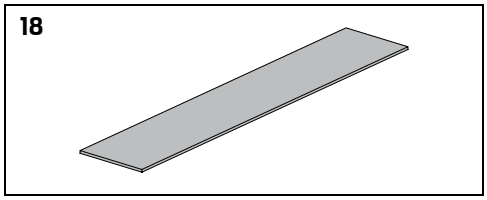












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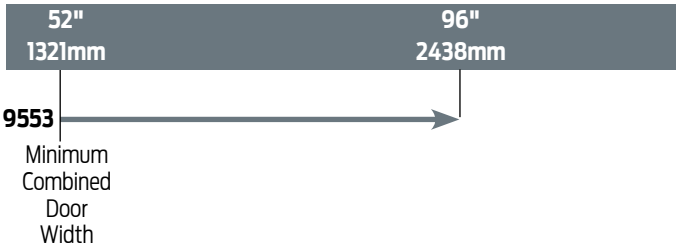
9550 SERIES

ORDERING INFORMATION

TABLE OF SIZES

COMBINED DOOR WIDTH



→ Indicates recommended range of door width for operator.

NOTE: For all Senior Swing Series.
Simultaneous Pair – Width per leaf 30˝ minimum to 48˝ maximum.

HOW-TO-ORDER 9550 SERIES OPERATORS

1. SPECIFY HAND

☐ RH
☐ LH

2. SPECIFY HEADER / LENGTH

☐ HL__ (Specify length 52˝ to 98˝) regular or long arm
☐ HL__ (Specify length 60˝ to 98˝) for standard or DE arm

3. SPECIFY FINISH

☐ Standard Anodized Finish _____ Aluminum or Dark Bronze.

Operator will be shipped with:
- STANDARD MOTOR GEARBOX (SF) (2 ea),
- STANDARD CONTROL BOX (SC),
- METAL COVER (at specified length 72˝ standard),
- REGULAR ARM (2 ea),
- 2-3/4˝ PIVOT POINT,
- MACHINE SCREW PACK

OPERATOR OPTIONS

MOUNTING PLATE

☐ Plate, ___ (Specify Length 52˝ to 101-1/2˝)

ARM

☐ Standard Arm (2 ea) w/Standard Track (2 ea)
☐ Double Egress Includes Standard Arm w/Track (1 ea) & Regular Arm (1 ea)
☐ Long Arm (3077L)

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SEM SERIES

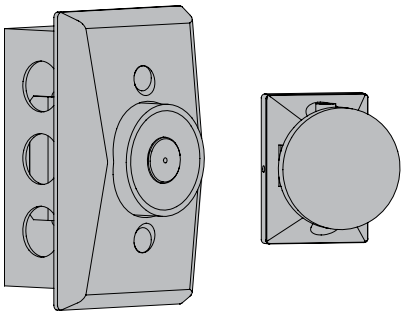
SEM 7840 MAGNET

Die cast housing, low profile recessed wall mount.

2″ (51 mm) x 4″ (102 mm) x 1-1/2″ (38 mm).

NOTE: Outlet box not included.

SEM 7840

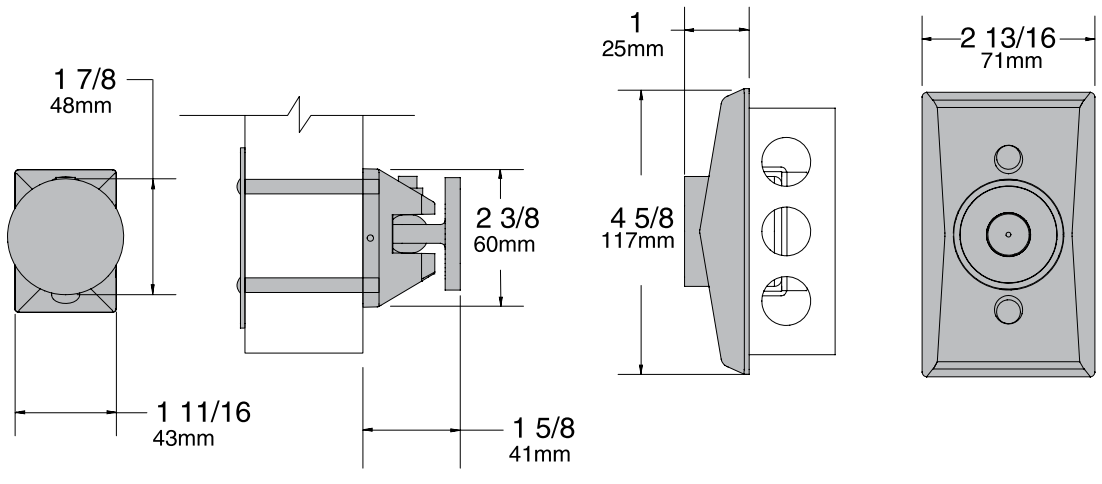


SEM FEATURES

- Tri-voltage design with 35 lbs. of holding force.
- Now available armature extensions from LCN (see page 11).
- SEM 7840 magnets are shipped with die cast housing, cover, armature and WMS screw pack.
- SEM 7840 available in Aluminum and Dark Bronze finishes only.
- Suitable for use in pocket door installations.
- UL listed for smoke barrier or labeled fire doors.

Total Projection = 2-5/8″ (67 mm)

Dimensions apply for both SEM 7840



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AUTOMATIC OPERATOR ACTUATORS & ACCESSORIES

8310 Series 36″ x 6″ Full Length Actuators

FULL LENGTH ACTUATOR (FLA), 8310-836T
Hardwired low voltage actuator with stainless steel touch plate with 36″ x 6″ ac va on surface. Blue handicap symbol conforms with most accessibility codes. Added "PUSH TO OPEN" lettering for enhanced identification. Designed to meet California building codes and increase accessibility for wheelchair bound entrants. Can easily be mounted to any flat surface or a bollard post.

FULL LENGTH ACTUATOR (FLA), 8310-836TW
Same as the 8310-836T with a built in wireless transmitter and 3v battery. Use in conjunction with 8310-865 Receiver (not included).

RECEIVER, 8310-865
Receiver, Wireless, 1 Channel, w/Sequencing Feature. Used in conjunction w/ Wireless Actuators & Transmitter(s).

TRANSMITTER, 8310-844
Transmitter, Wireless, 1 Channel, 9v Battery included. Used to convert standard actuators to wireless. Requires 8310-865 Receiver. Recommended for exterior application with 8310-836T.

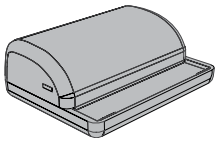
FLA BOLLARD POST 8310-866FLA
A powder coated steel 42″ x 4″ x 6″: Bollard Post, mounting base pre prepped for the 8310-836T. Includes 8310-866 CAP, 2 mounting screws & spacer for installation.

FLA BOLLARD MOUNT KIT 8310-3836T
36″ x 6″ Actuator with 8310-866FLA Bollard for wired applications.

FLA BOLLARD MOUNT 8310-3836TW
36″ x 6″ Actuator with 8310-866FLA Bollard and 8310-844 wireless Transmitter. Transmitter requires 8310-865 Receiver (not included).

8310-836T
8310-836TW

865



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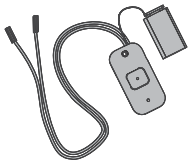
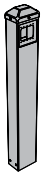
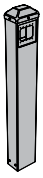


866FLA



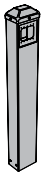
3836T

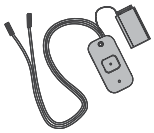


866FLA

8310-836T

3836TW





844

866FLA

8310-836T

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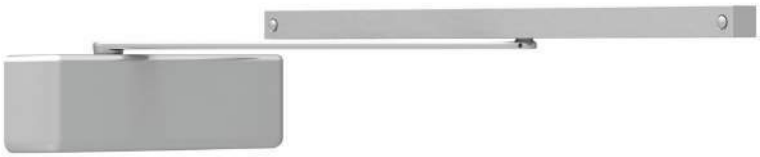
LCN®

Surface mounted closer

4000T Series



Overview

The 4000T is a heavy duty closer to reliably control fire and smoke barrier doors with maximum swing of 90º. Designed for use with an SEM 7850 wall magnet.

Cylinder

4003(4)T-3071
Cast iron cylinder assembly

Handing
Non-handed

Sizing
Sized 3 or 4

- 4003T (Size 3)
- 4004T (Size 4)

ALLEGION™

Finishes

Powder coat finishes

689
Aluminum

690
Statuary Bronze

691
Light Bronze

693
Black

695
Dark Bronze

696
Brass

150+ additional custom colors available using the RAL numbering system

Metal plated finishes

632
Bright Brass

633
Satin Brass

639
Satin Bronze

616
Satin Bronze, Blackened

646
Satin Nickel

651
Bright Chrome

652
Satin Chrome

Available finish options

MTLPC	Brite metallic: Custom powder coat finish, which resembles that of 651 or 652 plated finish.
SRI	For installations where a higher level of protection against weather conditions, or the effects of a potentially corrosive atmosphere is required, LCN offers a special rust inhibiting (SRI) process. Ferrous metal components receive an SRI pretreatment and a standard powder coat finish of your choice, or a custom powder coat finish for a nominal additional cost. Closers treated with the SRI process exceed the 100 hour protection level available with standard LCN powder coated finishes.

Covers

Standard cover

4000T-72
Plastic cover
- Non-handed

Optional cover

4000T-72MC
Metal cover
- Handed
- Required for plated finishes and custom powder coat finishes
- Optional

Arms

4000T-3077T
Standard arm
- Non-handed
- Roller not included with arm

Tracks

4000T-3038
Standard track
- Non-handed
- Non hold-open
- Will not accept hold-open clip or bumper assembly
- Standard

4000T-3034
Track roller
- Quiet, low friction roller assembly
- Shoulder Dimension "X"= 1/8″ (3 mm)

Fasteners

Self-reaming and tapping screws included standard

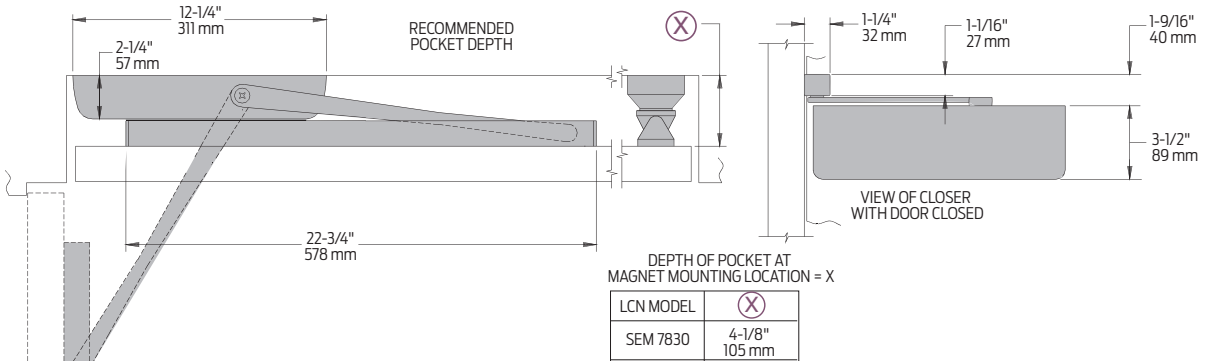
Fastener pack options

TBWMS	TB[1], wood and machine screw
TORX	TORX machine screw
TBTRX	TB[1] and TORX machine screw

1 Specify door thickness if other than 1 3/4"

Dimensions and mounting

Wall pocket mounting



DEPTH OF POCKET AT
MAGNET MOUNTING LOCATION = X

LCN MODEL	X
SEM 7830	4-1/8" 105 mm
SEM 7840	2-5/8" 67 mm
SEM 7850	3-5/8" 92 mm

Specifications

Accessibility	Available with less than 5.0 lbs. opening force on 36" door
Certifications/ approvals	▪ Grade 1 - ANSI A156.4 ▪ UL 10C ▪ Meets BAA - Buy American Act
Degree of operation	Wall pocket mount Max opening: 90° Hold open: 90° with magnet
Environmental conditions	▪ Approved for interior use ▪ Approved for exterior use (SRI coated only) ▪ LCN's standard all weather fluid performs to temperature ranges from 120°F (49°C) to -30°F (-35°C) ▪ LCN's powder coat finish surpasses 100 hours of salt spray which is over four times the ANSI standard for corrosion resistance.
Warranty	30 years
Standard features	▪ Cast iron body ▪ Full complement bearing ▪ 1 1/2" diameter piston ▪ 3/4" diameter double heat treated pinion journal

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ALLEGION™

LCN®

Surface mounted closer

4040XP Series

Overview

The 4040XP is LCN's most durable and flexible heavy duty closer designed for institutional and other demanding high traffic applications.

Cylinder

4040XP-3071
Cast iron cylinder assembly

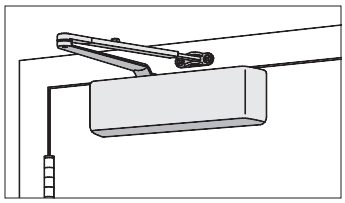
Handing
Non-handed

Sizing
Adjustable spring size 1-6, includes patented Green Dial

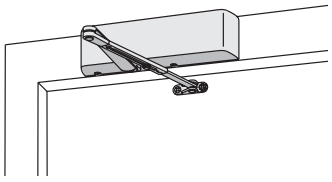
Available cylinder options

DEL	Delayed action cylinder

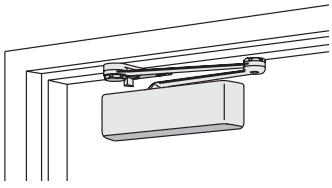
Mounting



Hinge (pull side)



Top jamb (push side)



Parallel arm (push side)

ALLEGION™

Finishes

Powder coat finishes

689
Aluminum

690
Statuary Bronze

691
Light Bronze

693
Black

695
Dark Bronze

696
Brass

150+ additional custom colors available using the RAL numbering system

Metal plated finishes

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Bright Brass

633
Satin Brass

639
Satin Bronze

616
Satin Bronze, Blackened

646
Satin Nickel

651
Bright Chrome

652
Satin Chrome

Available finish options

MTLPC	Brite metallic: Custom powder coat finish, which resembles that of 651 or 652 plated finish.
SRI	For installations where a higher level of protection against weather conditions, or the effects of a potentially corrosive atmosphere is required, LCN offers a special rust inhibiting (SRI) process. Ferrous metal components receive an SRI pretreatment and a standard powder coat finish of your choice, or a custom powder coat finish for a nominal additional cost. Closers treated with the SRI process exceed the 100 hour protection level available with standard LCN powder coated finishes.

Covers

Standard cover

4040XP-72
Plastic cover
- Non-handed
- Includes 4040XP-54 snap-on cover clip

Optional cover

4040XP-72MC
Metal cover
- Handed
- Required for plated finishes and custom powder coat finishes
- Optional

Arms

4040XP-3077
Regular arm
- Non-handed
- Mounts pull side or top jamb with shallow reveal P4041 closer includes PA SHOE, 4040XP-62PA required for parallel arm mounting

4040XP-3077L
Long arm
- Non-handed
- Includes LONG ROD AND SHOE, 4040XP-79LR for top jamb mount
- Optional

4040XP-3077ELR
Extra long arm
- Non-handed
- Includes EXTRA LONG ROD AND SHOE, 4040XP-79ELR for top jamb mount with deep reveal
- Optional

4040XP-3049
Hold-open arm
- Non-handed
- Mounts pull side or top jamb with shallow reveal, hold-open adjustable shoe
- 4040XP closer includes 4040XP-62PA shoe required for parallel arm mounting
- Optional

4040XP-3049L
Long hold-open arm
- Non-handed
- Includes LONG HEAD AND TUBE, 4040XP-3048L for top jamb mount
- Optional

4040XP-3077EDA
Extra duty arm
- Non-handed
- Features forged, solid steel main and forearm for potentially abusive installations
- Optional

4040XP-3049EDA
Hold-open extra duty arm
- Handed
- Parallel arm features forged, solid steel main and forearm for potentially abusive installations
- Hold-open function is adjusted at the shoe
- Optional

4040XP-3077EDA/62G
Extra duty arm with 62G
- Non-handed
- Features forged, solid steel main and forearm for potentially abusive installations
- 62G shoe provides additional blade stop clearance
- Optional

4040XP-3049EDA/62G
Hold-open extra duty arm with 62G
- Handed
- Features forged, solid steel main and forearm for potentially abusive installations
- 62G shoe provides additional blade stop clearance. Hold-open function is adjusted at the shoe
- Optional

4040XP-3077CNS
Cush-N-Stop® Arm
- Non-handed
- Features solid forged steel main arm and forearm with stop in soffit shoe.
- Optional

4040XP-3049CNS
HCUSH arm
- Non-handed
- Hold-open function with templated stop/hold-open points
- Handle controls hold-open function
- Optional

4040XP-3077SCNS
Spring CUSH arm
- Non-handed
- For potentially abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe
- Optional

Arms

4040XP-3049SCNS
Spring HCUSH arm

- Non-handed
- For potentially abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe
- Handle controls hold-open function
- Optional

Installation accessories

4040XP-18
Plate
- Required for hinge side mount where top rail is less than 3 3/4″ (95 mm)
- Requires minimum 2″ (51 mm) minimum top rail

4040XP-18G
Plate
- Locates top jamb mounted closer flush with top of head frame face in flush ceiling condition
- Requires 1 3/4″ (44 mm) minimum head frame

4040XP-18TJ
Plate
- Centers top jamb mounted closer vertically on head frame where face is less than 3 1/2″ (89 mm). Plate requires 1 3/4″ (44 mm) minimum head frame

4040XP-18PA
Plate
- Required for parallel arm mounting where top rail is less than 5 1/2″ (140 mm), measured from the stop
- Requires 2″ (51 mm) minimum top rail

4040XP-62PA
PA shoe
- Required for parallel arm mounting

4040XP-30
CUSH shoe support
- Provides anchorage for fifth screw used with CUSH arms, where reveal is less than 3 1/16″ (78 mm)
- Optional

4040XP-61
Blade stop spacer
- Required to lower parallel arm shoe to clear 1/2″ (13 mm) blade stop
- Optional

4040XP-419
PA flush panel adapter
- Provides horizontal mounting surface for parallel arm shoe on single rabbeted or flush frame
- Optional

Installation accessories

4040XP-62A
Auxiliary shoe
- Requires a top rail of 7″ (178 mm)
- Shoe replaces -62PA for parallel arm mounting of regular arm with overhead holder/stop
- Optional

4040XP-54
Snap-on cover clip
- Used to secure 4040XP-72 plastic cover to cylinder body

Fasteners

Self-reaming and tapping screws included standard

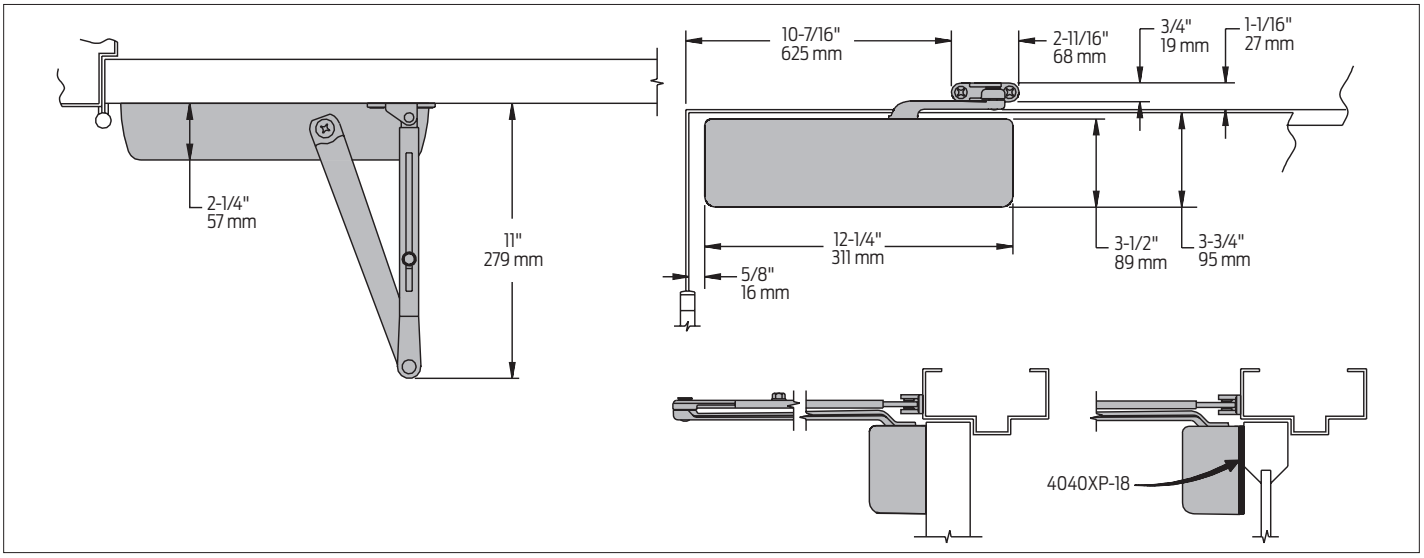
Fastener pack options

TBSRT	TB[1] with self-reaming and tapping screws
WMS	Wood and machine screw
TBWMS	TB[1], wood and machine screw
TORX	TORX machine screw
TBTRX	TB[1] and TORX machine screw

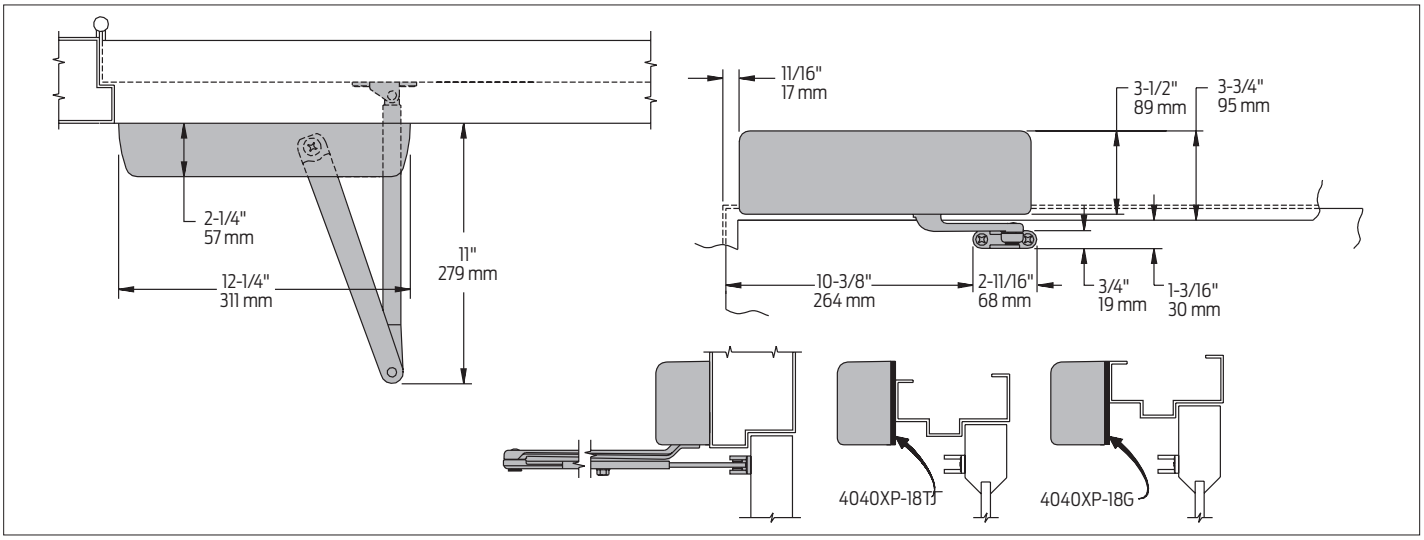
1 Specify door thickness if other than 1 3/4"

Dimensions and mounting

Hinge (pull) side mounting

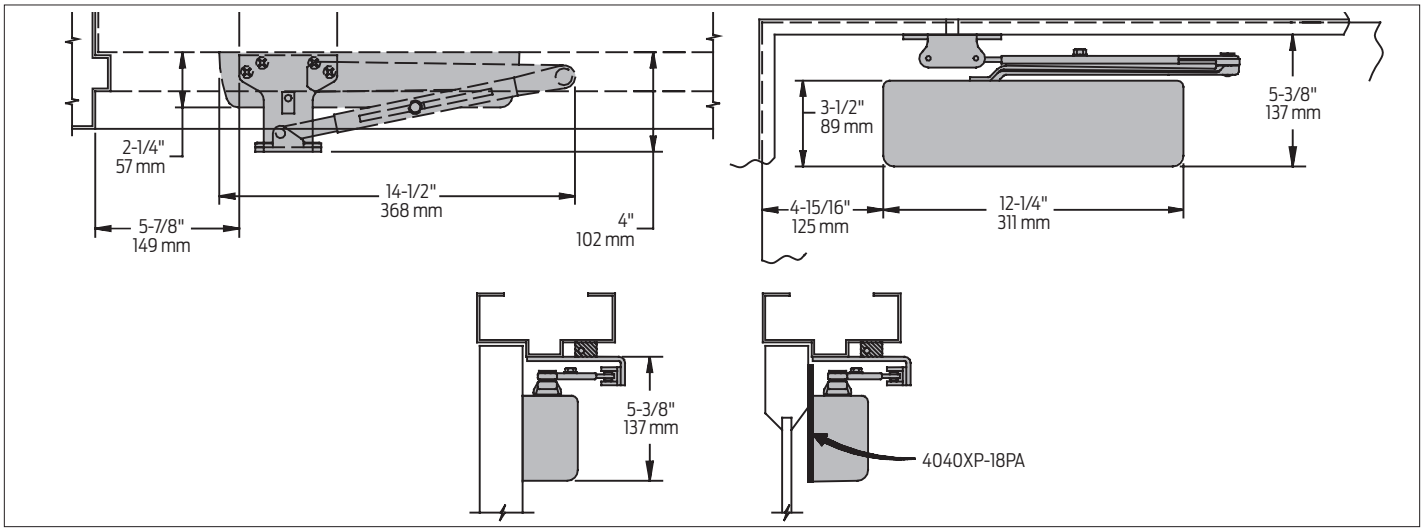


Top jamb (push side) mounting

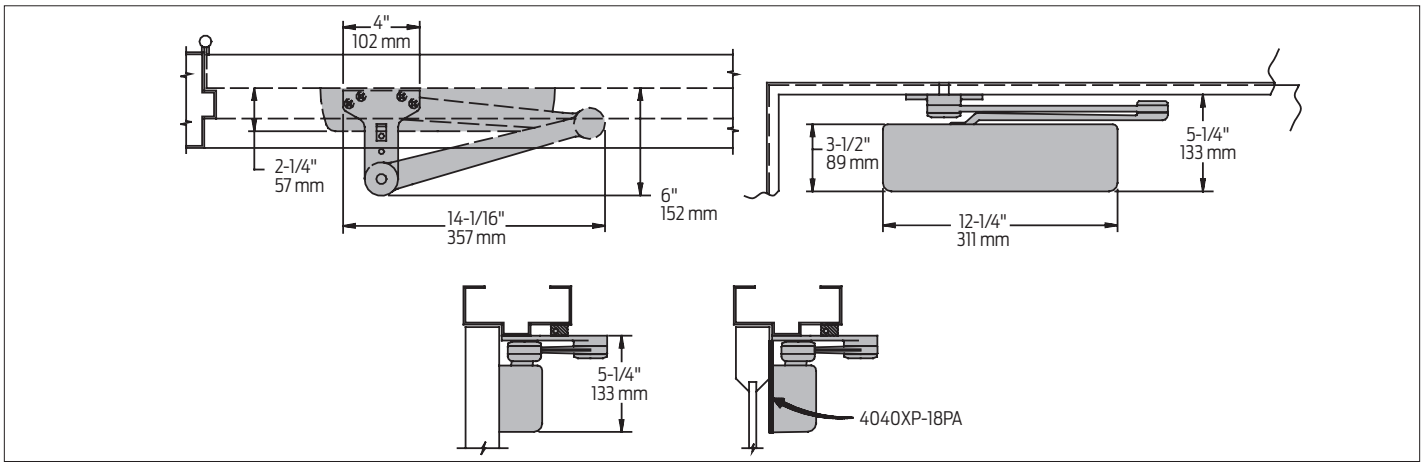


Dimensions and mounting

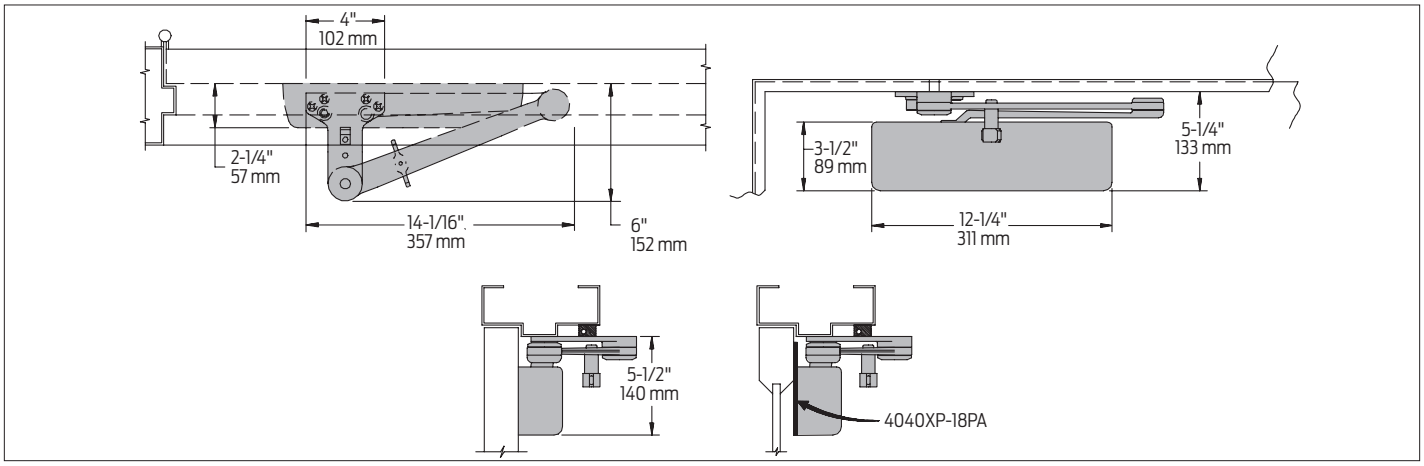
Parallel arm (push side) mounting



EDA mount



CUSH mount



Specifications

Accessibility	Available with less than 5.0 lbs. opening force on 36" door
Certifications/ approvals	▪ Grade 1 - ANSI A156.4 ▪ UL 10C ▪ Meets BAA - Buy American Act
Degree of operation	Hinge (pull) side Max opening: 120° Hold open: 90-120° Top jamb (push side) mount Max opening: 120° Hold open: 85-120° Parallel arm with 62PA Max opening: 180° Hold open: 180° EDA Max opening: 180° Hold open: 180° Cush and spring cush Max opening: 110° Hold open: 110°
Environmental conditions	▪ Approved for interior use ▪ Approved for exterior use (SRI coated only) ▪ LCN's standard all weather fluid performs to temperature ranges from 120°F (49°C) to -30°F (-35°C) ▪ LCN's powder coat finish surpasses 100 hours of salt spray which is over four times the ANSI standard for corrosion resistance.
Warranty	30 years
Standard features	▪ Cast iron body ▪ Full complement bearing ▪ 1 1/2" diameter piston ▪ 11/16" diameter double heat treated pinion journal

013110, Rev. 1/2020

ALLEGION

SCHLAGE

PS906

6 amp power supply

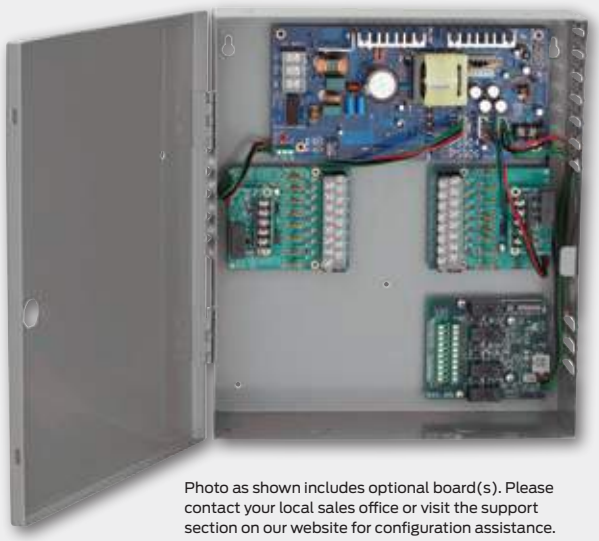


Photo as shown includes optional board(s). Please contact your local sales office or visit the support section on our website for configuration assistance.

Overview

The Schlage comprehensive line of power supplies and option boards was designed to address the changing needs of the access control market.

Installation is simplified by utilizing a flat mounting design and polarized locking connectors for option boards. This design eliminates the need for racks and side connectors. The flat mounting of the option boards also provides for easier access to the terminal blocks for connection of electrified devices (such as electrified strikes, electromagnetic locks, card readers, etc.).

Common to the line of PS900 Series power supplies is a constant output rating at both 12v and 24v settings, universal 120 VAC to 240 VAC input, and polarized option board connectors. New fire alarm interface board mounting allows outputs to be configured as switched (power cut) or unswitched (power continues) when signal is provided.

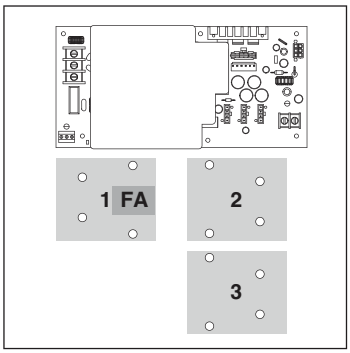
Features and benefits

- 6A @ 12/24 VDC constant output, field selectable with jumper
- Provides low-voltage, Class 1, filtered and regulated power (Class 2 when used with 900-8P option board)
- Universal 120-240 VAC, fused primary input
- Three polarized option board connectors eliminate need for racks and side connectors
- AC input and DC output monitoring circuit with LED indicators
- Externally visible AC input indicator with isolated SPDT contacts
- High-voltage protective cover for AC circuitry (not shown)
- Battery back-up board auto-selects voltage
- Optional Fire Alarm plug-in board available
- UL 294, ULC-S318, RoHS, and FCC Part 15 certified

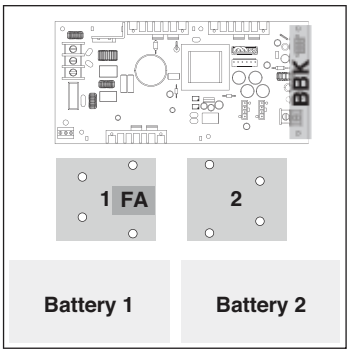
Configuration options

Available option board, fire alarm and battery backup connection locations:

PS906 without battery backup



PS906 with battery backup



Exit device support

Von Duprin QEL	Up to 8[1]
Von Duprin EL	None
Falcon EL	None

1. Requires the use of two 900-4RL option boards

PS906 power supply specifications

Specification	Description
Input voltage	120/240 VAC, 50/60 Hz, universal input
Output voltage	6A @ 12 or 24 VDC Field selectable with jumper Switching supply, 5% regulation, 240mVpp max ripple
Enclosure	Grey/baked enamel 14"x 12"x 4" (H x W x D) Eight ½" x ¾" knockouts NEMA Grade 1 Hinged cover with lock down screws
Operating temperature	32º - 120ºF (0º - 49ºC)
Certifications	ANSI/UL 294 ULC-S318 RoHS FCC Part 15 Class 1 (Class 2 when used with 900-8P option board)
Battery backup (install on main board)	900-BB: Battery backup board only 900-BBK: Battery backup kit (backup board plus battery pack)
Available option boards	900-FA: Plug-in fire alarm (must be installed on option board) 900-2RS*: 2 Relay option board capable of individual or sequential operation for single and pair door applications 900-4R*: 4 Relay option board 900-4RL*: 4 Relay option board with integrated logic and individual or sequential operation capability for controlling security interlocks, auto operators and time delay function 900-8F*: Fused, 8 zone option board 900-8P*: PTC, 8 zone option board
AC primary fuse size	6.3A, 250v, 5 x 20 mm
Battery fuse size	7.5A 32v ATO blade style
DC output protection	Overload protection - current limited foldback circuit
Indicators	LED indicators: - AC input (visible on outside of enclosure) - DC output Isolated SPDT contacts to monitor AC power status
Weight (power supply)	Approx. 9.0 lbs
Weight (each battery)	4.0 lbs
AC input termination	3 position terminal block with protective cover Wire capacity: 10 AWG max.
DC output termination	2 position terminal block Wire capacity: 12 AWG max.
Option board connectors	3
Fire alarm board connector	Yes (requires connection on option board)
Keylock	Optional
Accessories	900-BAT: Backup battery pack

* Compatible with plug-in fire alarm board (900-FA)

About Allegion

Allegion (NYSE: ALLE) is a global pioneer in safety and security, with leading brands like CISA®, Interflex®, LCN®, Schlage® and Von Duprin®. Focusing on security around the door and adjacent areas, Allegion produces a range of solutions for homes, businesses, schools and other institutions. Allegion is a $2 billion company, with products sold in almost 130 countries. For more, visit **www.allegion.com.**

aptiQ ■ LCN ■ SCHLAGE ■ STEELCRAFT ■ VON DUPRIN

ALLEGION™

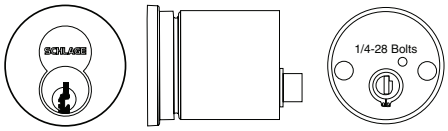
004193, Rev. 08/16
www.allegion.com/us

Small Format Interchangeable Core Cylinders for Schlage Locksets

Small Format Core Only

Number	Mechanism
80-036	7-pin Everest B Family restricted keyway core uncombinated
80-037	7-pin Everest B Family restricted keyway core combinated
80-043	6-pin Best keyway core, uncombinated
80-033	7-pin Best keyway core, uncombinated

Notes 1. Available 606 and 626 finish only.
2. Suffix keyway, e.g. 80-036 B235, 80-043 AB, etc.
3. Proper authorization required for Everest cores. Order control keys separately.
4. 80-043 and 80-033 available in Best A, D, E, F, G, H, J, K, L and M keyways. Suffix "B" to keyway letter, e.g. AB, DB, etc.

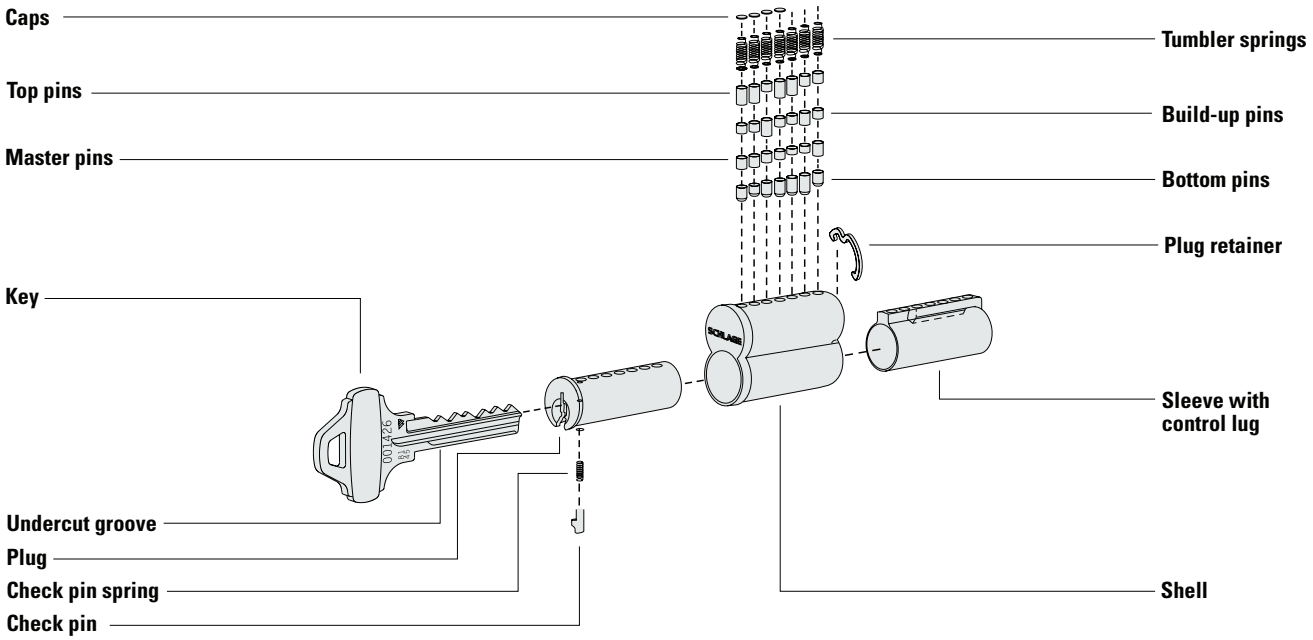


Small Format IC Housings for Commercial Deadlocks, Less Core

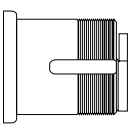
Lockset Series	Description	Number	Specify Finish
B500-Series	Outside	B610-204	605, 609, 612, 613, 619, 625, 626, and 716
	Inside	B610-281**	605, 609, 612, 613, 619, 625, 626, and 716
B600-Series	Outside	B610-282	605, 606, 609, 612, 613, 625, 626
	Inside	B610-281	See Note Below

Note: To order Primus XP add the suffix - XP to the Primus part number. (Example: 12-345-XP)

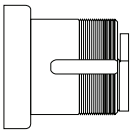
Tailpieces not included.
Specify finish of B610-014 snap-on faceplate ordered separately for inside of BC162 and B662.
**Inside housing does not include snap-on faceplate



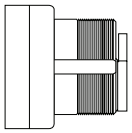
Small Format Interchangeable Core Mortise Cylinders



Cylinder Only



Compr. Ring & Spring



With Blocking Ring

Cylinders for Schlage L-Series Mortise Locks

	Design	Function	Core Mechanism			
			Everest Restricted (GD Suffix)	Keyed Construction (HD Suffix)	Disposable Construction (BDC Suffix)	Housing Less Core (BD Suffix)
	**L & N Escutcheons** (cylinders with compression ring and spring)	All Except L9060 Outside	80-308	80-138	80-115	80-108
		L9060P Outside	80-304	80.134	80.134	80-104
	**Sectional Trim** (cylinder with compression ring, spring and 1/4" blocking ring).	All* Except L9060 Outside	80-301	80-131	80-131	80.101
		L9060 Outside	80-304 + 36-082-050	80-134 36-082-050	80-134 36-082-050	80-104 36-082-050

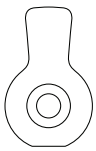
L583-255
Cam for All Functions Except L9060 Outside

K510-680
Cam for L9060 Outside

Notes 1. Available 605, 606, 612, 613, 625, and 626 finish. Cores furnished 606 and 626 only.
2. All cylinders are 1 3/8" long.

Mortise Cylinders with Straight Cam for Exit Devices

Number	Core Type
80-302	Everest restricted core
80-110	Disposable constr. core
80-132	Keyed constr. core
80-102	Housing less core



K510-730
Straight Cam, Other Applications

Furnished with compression ring, spring and 1/4" blocking ring.

Notes 1. Available 605, 606, 612, 613, 625, and 626 finish. Cores furnished 606 and 626 only.
2. All cylinders are 1 3/8" long.

Small Format Interchangeable Core Cylinders for Exit Devices, Aluminum Doors

Interchangeable Core Rim Cylinders for Exit Devices

Number	Core Mechanism
80-329	Everest restricted keyway core
80-159	Keyed construction core
80-116	Disposable construction core
80-129	Less core

Available 605, 606, 609, 610, 612, 613, 625 and 626 finish.

Mortise Cylinders with Straight Cam for Exit Devices

Number	Core Type
80-303	Everest restricted core
80-111	Disposable constr. core
80-133	Keyed constr. core
80-103	Housing less core

Furnished with compression ring, spring and 7/16″ blocking ring.
These cylinders include set screw pack B220-050 for Adams Rite locks.

K510-711
Adams Rite
MS Cam

KS21F KS72F KS92M

Padlocks

Part #	Shackle Dimensions					
	Width	Height	Depth	A	B	C
LESS CYLINDER - SMALL FORMAT INTERCHANGEABLE CORE						
CHROME BRASS BODY						
KS11A1200	1 25/32″	2 3/16″	7/8″	1/4″	3/4″	3/4″
KS11D1200	1 25/32″	2 3/16″	7/8″	1/4″	1 1/2″	3/4″
KS11F1200	1 25/32″	2 3/16″	7/8″	1/4″	2″	3/4″
KS11G1200	1 25/32″	2 3/16″	7/8″	1/4″	4″	3/4″
KS21A1200	1 25/32″	2 3/16″	7/8″	5/16″	3/4″	3/4″
KS21D1200	1 25/32″	2 3/16″	7/8″	5/16″	1 1/2″	3/4″
KS41F1200	1 25/32″	2 3/16″	7/8″	5/16″	2″	3/4″
KS21G1200	1 25/32″	2 3/16″	7/8″	5/16″	4″	3/4″
KS41A1200	1 15/16″	2 3/16″	7/8″	3/8″	3/4″	3/4″
KS41D1200	1 15/16″	2 3/16″	7/8″	3/8″	1 1/2″	3/4″
KS41F1200	1 15/16″	2 3/16″	7/8″	3/8″	2″	3/4″
KS41G1200	1 15/16″	2 3/16″	7/8″	3/8″	4″	3/4″
STEEL BODY						
KS72M1200	2 5/8″	2 3/8″	1 3/32″	7/16″	1″	7/8″
KS72F1200	2 5/8″	2 3/8″	1 3/32″	7/16″	2″	7/8″
KS82M1200	1 13/16″	3 7/16″	1 3/32″	5/16″	1″	3/4″
KS92M1200	2 1/8″	3 7/16″	1 3/16″	3/8″	1″	3/4″

Cylinders for Adams Rite 4070 Series Deadlocks

Number	Core Type
80-305	Everest restricted core
80-113	Disposable constr. core
80-135	Keyed constr. core
80-105	Housing less core

Furnished with compression ring, spring and 1/4″ blocking ring

B520-378
Adams Rite
4070 Cam

Notes 1. Available 605, 606, 612, 613, 625, and 626 finish. Cores furnished 606 and 626 only.
2. All cylinders are 1 3/8″ long.

Locking Cables KC Series

Part #	Length	Diameter
LESS CYLINDER - SMALL FORMAT INTERCHANGEABLE CORE		
LOCKING CABLES		
KC215A130	2″	5/8″
KC215B130	4″	5/8″
KC215E130	6″	5/8″

SCHLAGE

Grade 1, mortise locks

L Series

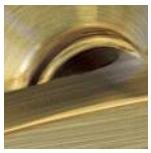
Overview

The Schlage® L Series has long been the benchmark for Grade 1 mortise locks. Beyond strength and security – it offers flexibility to meet most needs. Fifty mechanical functions include ten that can be field configured from one universal lock case and ten electrified functions are regularly used as part of electronic access control systems. L Series locks have the ability to suite across electronic, tubular, exit trim, and multi-point locks to integrate seamlessly into any environment. The series features an array of security options including 180-degree visibility status indicators and support for multiple keyway families and cylinder types including Primus® XP high-security cylinders.

Finishes

605
Bright Brass

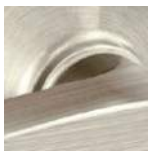
606
Satin Brass



609
Antique Brass

612 [1]
Satin Bronze

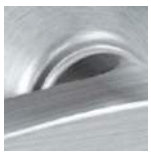
613 [1]
Oil Rubbed Bronze



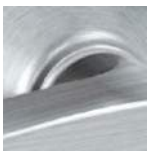
619
Satin Nickel

622
Matte Black

625
Bright Chrome



626
Satin Chrome



626AM
Satin Chrome, Antimicrobial

629 [2]
Bright Stainless

630 [2]
Satin Stainless

630AM [2]
Satin Stainless, Antimicrobial

643e
Aged Bronze

[1] Available on standard levers only, not available on Latitude, Longitude, Accent, Asti, or Merano

[2] Not available on Accent, Asti, or Merano

ALLEGION

Standard lever and knob styles

01
801 - Milled tactile warning

02
802 - Knurled tactile warning

03
803 - Knurled tactile warning

05
805 - Milled tactile warning

06
806 - Milled tactile warning

07
807 - Milled tactile warning

12
812 - Milled tactile warning
- Handed

17
817 - Milled tactile warning

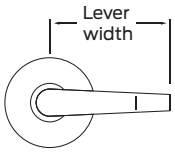
18
818 - Milled tactile warning

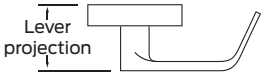
Accent (ACC)[1]
- Handed

Dimensions

Lever	Width	Projection
01	3.875"	2.688"
02	4.75"	2.813"
03	4.75"	2.813"
05	3.75"	2.875"
06	4.625"	2.5"
07	4.625"	2.875"
12	4.625"	3.063"
17	4.75"	3"
18	4.875"	2.688"
Accent (ACC)	4.125"	3.125"

Return to door meets 1/2" requirement for 03, 06 and 17 levers.





[1] Not available in 612, 613, 629, or 630 finishes.

Escutcheons

L full face
Specify by adding 'L' after lever design.

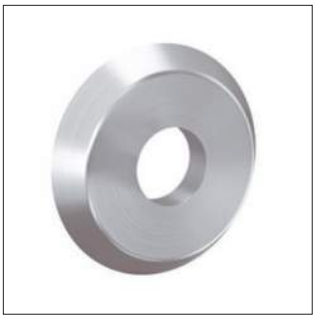
L concealed
Specify by adding 'C' suffix to function and by adding 'L' after lever design.

N full face
Specify by adding 'N' after lever design.

Roses

A rose
Available for use on L Series knob and lever designs. Specify by adding 'A' after lever design
Finishes: available in all L Series finishes.

B rose
Available for use on L Series knob and lever designs. Specify by adding 'B' after lever design.
Finishes: available in all L Series finishes.



C rose
Available for use on L Series knob and lever designs. Specify by adding 'C' after lever design.
Finishes: 605, 606, 609, 619, 622, 625, 626, 629, 630, 643e

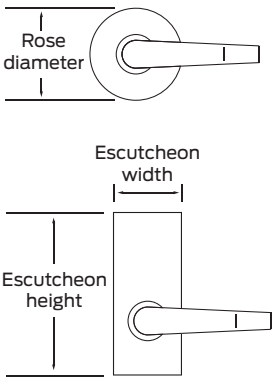
AVA rose
Available for use on ACC lever, other levers upon request.
Finishes: 605, 606, 609, 619, 622, 625, 626, 643e

MER rose
Available for use on MER lever, other levers upon request.
Finishes: 605, 606, 609, 619, 622, 625, 626, 643e

Dimensions

Rose	Diameter
A	2.125"
B	2.5625"
C	2.625"
AVA	2.625"
MER	2.625"

Escutcheon	Width	Height
L full face	1.75"	8"
L concealed	1.75"	8"
N full face	2.5"	7.875"



Thumbturns

Standard turn
09-509

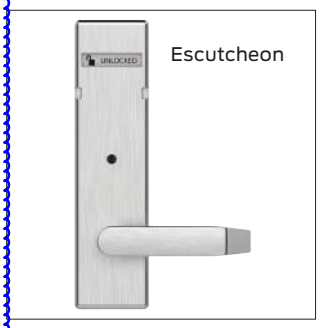
ADA turn
09-509 x L583-363
Not available with L9463 and L463

Indicators

Cylinder

Thumbturn

Cointurn



Emergency key indicator

Cylinder

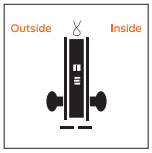
Thumbturn

Cointurn

Emergency key indicator

	🔒 Locked 🔓 Unlocked	🔒 Occupied 🔓 Unoccupied	Do Not Disturb	🔒 🔓
Inside trim	L283-711	L283-712	L283-713	L283-714
Outside trim	L283-721	L283-722	L283-723	L283-724

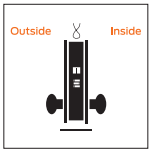
Electrified locks functions



Schlage **L9090EL**
L9090EU
ANSI **F13**

Electrically locking/ unlocking outside lever (no cylinder)

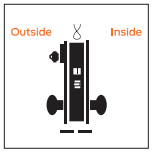
- Outside lever/knob continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever/knob always free for immediate egress



Schlage **L9091EL**
L9091EU
ANSI **-**

Electrically locking/ unlocking both levers (no cylinder)

- Both levers/knobs continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Auxiliary latch deadlocks latchbolt when door is locked

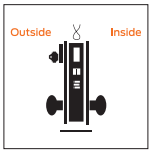


Schlage **L9092EL**
L9092EU
ANSI **-**

Electrically locking/ unlocking outside lever (single cylinder)

- Outside lever/knob continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Latchbolt retracted by lever/knob inside or key outside
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever/knob always free for immediate egress
- EL: Switch or power failure allows outside lever/knob to retract latchbolt
- EU: Switch or power failure locks (EU) outside lever/knob

Optional HSLR trim available

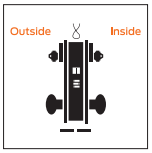


Schlage **L9093EL**
L9093EU
ANSI **-**

Electrically locking/ unlocking both levers (outside cylinder)

- Both levers/knobs continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Latchbolt retracted by key outside
- Auxiliary latch deadlocks latchbolt when door is locked

Optional HSLR trim available

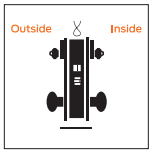


Schlage **L9094EL**
L9094EU
ANSI **-**

Electrically locking/ unlocking outside lever (double cylinder)

- Outside lever/knob continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Lathbolt retracted by either key or by inside lever/knob
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever/knob always free for immediate egress

Optional HSLR trim available



Schlage **L9095EL**
L9095EU
ANSI **-**

Electrically locked or electrically unlocked both levers (double cylinder)

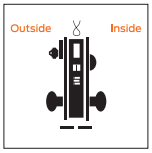
- Both levers/knobs continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Latchbolt retracted by either key
- Auxiliary latch deadlocks latchbolt when door is locked
- EL: Switch or power failure unlocks both levers/knobs and allows knob/lever to retract latchbolt
- EU: Switch or power failure locks both levers/ knobs

Optional HSLR trim available

Cylinder · Knob/lever · Thumbturn · Thumbturn cylinder · Coin turn · Solid spindle · Two-piece spindle · Emergency thumbturn · Electrified function

ALLEGION

Electrified locks functions

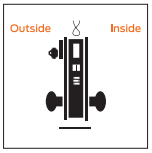


Schlage **L9492EL**
L9492EU
ANSI **-**

Electrically locking/ unlocking outside lever (outside cylinder, inside thumbturn with deadbolt)

- Outside lever continuously locked (EL) or unlocked (EU) 12V or 24V DC
- Deadbolt actuation by key or thumbturn
- Inside lever retracts both deadbolt and latchbolt
- For EU outside lever retracts deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress

Optional HSLR trim available

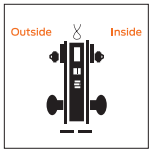


Schlage **L9493EL**
L9493EU
ANSI **-**

Electrically locking/ unlocking both levers (outside cylinder, inside thumbturn with deadbolt)

- Deadbolt actuation by key or thumbturn
- Inside lever retracts both deadbolt and latchbolt
- For EU both levers retract deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked

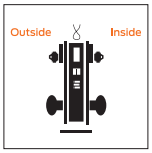
Optional HSLR trim available



Schlage **L9494EL**
L9494EU
ANSI **-**

Electrically locking/ unlocking outside lever (double cylinder with deadbolt)

- Outside lever continuously locked (EL) or unlocked (EU) 12V or 24V DC
- Deadbolt actuation by either key
- Inside lever retracts both deadbolt and latchbolt
- For EU outside lever retracts deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



Schlage **L9495EL**
L9495EU
ANSI **-**

Electrically locking/ unlocking both levers (double cylinder with deadbolt)

- Both levers continuously locked (EL) or unlocked (EU) 12V or 24V DC
- Deadbolt actuation by either key
- When unlocked both levers retract deadbolt and open door
- Auxiliary latch deadlocks latchbolt when door is locked

Available electrified options include:

RX Request to Exit

LX Latch bolt monitor

DPS Door Position Switch

DM Deadbolt monitor (DM)

Cylinder · Knob/lever · Thumbturn · Thumbturn cylinder · Coin turn · Solid spindle · Two-piece spindle · Emergency thumbturn · Electrified function

Cylinders

Conventional mortise cylinder	
P	6-pin Conventional (standard) with Schlage logo
Z	SL 7-pin Conventional (A2 pinning) with Schlage logo
L	Less full face cylinder
C	Concealed mortise cylinder
W	Less concealed mortise cylinder

Full size interchangeable core (FSIC) mortise cylinder	
R	6-pin FSIC with Schlage logo
M	SL 7-pin FSIC (A2 pinning) with Schlage logo
J	Less FSIC
F	6-pin FSIC less Schlage logo
T	Refundable FSIC construction core

Small format interchangeable core (SFIC) mortise cylinder	
G	7-pin SFIC (A2 pinning) with Schlage logo
B	Less core
BDC	Disposable SFIC construction core
H	Refundable SFIC construction core

Specifications

Chassis	
Case material	CRS with zinc dichromate plating
Case size	L9000 Series: 4 7/16" x 6 1/16" x 1"(113 mm x 154 mm x 25 mm) L400 Series: 4 7/16" x 3 5/8" x 1"(113 mm x 92 mm x 25 mm)
Spacing	Knob or lever to cylinder: 3 7/8" (98 mm); Knob or lever to thumbturn hub: 2 11/16" (68 mm)
Door thickness	Standard: 1 3/4" (44 mm) Optional: 1 3/8" (35 mm) to 2 1/2" (64 mm) Over 2 1/2" (64 mm) door ranges vary by function. Specify door thickness if other than 1 3/4" and position in door EE, EI, EO, ED

Trim	
Handing	L9000 Series: Field-reversible without disassembly L400 Series: Non-handed
Lever/knob	Lever designs: forged brass or bronze and cast stainless steel Knob designs: heavy-duty wrought brass, bronze or stainless steel
Rose/ escutcheon	L full face and concealed: Cold-forged brass, bronze and stainless steel N full face: Heavy wrought reinforced brass, bronze and stainless steel Roses: A ,B, C: wrought brass or bronze and stainless steel; AVA and MER: forged brass
Combinations	Available with knob both sides, lever both sides, or knob/lever combinations. Roses cannot be combined with escutcheons.

Latch	
Backset	2 3/4" (70 mm) only
Armor	L9000 Series Standard: 1 1/4" x 8" x 7/32" (32 mm x 203 mm x 6 mm) Optional: 1 1/16" x 8" x 7/32" (27 mm x 203 mm x 6 mm) L400 Series: Standard: 1 1/4" x 5 9/16" x 7/32"(32 mm x 141 mm x 6 mm)
Latch	3/4" (19 mm) throw stainless steel latch with anti-friction tongue
Deadbolt	1" (25 mm) throw stainless steel deadbolt
Strike	L9000 Series Standard: ANSI curved lip strike 1 1/4" x 4 7/8" (32 mm x 124 mm) x 1 3/16" (30 mm) lip to center with dust box Optional: Extended lip strike options (7/8", 1", 1 1/2", 1 3/4", 2") L400 Series Standard: 1 1/8" x 3 1/2" (29 mm x 89 mm) with dust box Optional: 1 1/4" x 4 7/8"(32 mm x 124 mm) with dust box

Specifications

Keying	
Cylinder format	6-pin Conventional mortise cylinder (standard); also available in concealed mortise cylinder, FSIC, SFIC and 7-pin SL cylinder formats plus less cylinder options.
Keyway	Patented Everest 29 S123 (standard); also available in open, restricted, and Primus XP security levels with available master keying and construction keying.
Wired electrified	
Input voltage	12V or 24V DC for L909X
Operating mode	Fail Safe or Fail Secure via switch on chassis
Current draw	0.23 amps maximum; 0.01 amps holding
Request to Exit	Rating: 3A @ 125V AC/2A @ 30V DC. Available on all L909X and L949X electrified functions. Also available option for the following mechanical functions: L9010/50/56/70/71/80 and L9453/56/58/65/66/80/85.
Latch bolt monitor	Available on all L909x and L949x electrified and L9010/25/26/50/56/70/71/80/82 and L9453/56/65/66/80/85 mechanical functions.
Door position sensor	Internal available on L909x electrified and L9010/80/82 mechanical functions; external available on all functions.
Deadbolt monitor	Available on L949x electrified and L9453/56/57/58/80/85/86/96 mechanical functions
Warranty	
	3 year limited mechanical and 1 year limited electromechanical
Certifications	
ANSI/BHMA	L/LV9000: ANSI/BHMA A156.13-2017 Series 1000, Grade 1 operation and security; with FSIC Grade 2; with SFIC Grade 3 L400: ANSI/BHMA A156.36, Grade 1
ICC	Complies with ICC A117.1 Accessible and Usable Buildings and Facilities
UL/cUL	Mechanical: UL 10C and CAN/ULC-S104 3 hour fire listed; all locks listed for A label single doors, 4' x 10' and pairs 8' x 10' Electrified: UL/ULC listed for single-point locking applications; UL listed for 3-hour fire door (except L9076 and L9077)
CA Fire Code	All levers with a return to door of 1/2" (64 mm) or less comply
FL Building Code	Miami-Dade NOA's and Florida Building Commission listings
Federal	BAA compliant, all functions

013141, Rev. 07/2019
www.allegion.com/us

SCHLAGE

Grade 1 cylindrical locks

ND Series

Overview

The Schlage® ND Series is ANSI/BHMA Grade 1 certified and performs beyond the Grade 1 standards. The lock withstands 3,100 in-lb. of abusive lever torque, as well as 1,600 lbs. of offset lever pull for protection against pry bar attacks. The lock is not only strong from attacks, but it also shows nearly zero droop or wobble after 16 million cycles.

All ND Series locks come in 10 finishes, nine lever designs and use an ANSI 161 door preparation, commonly used with cylindrical locks. They are ideal for all new construction and retrofit applications.

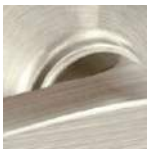
Finishes

605
Bright Brass

606
Satin Brass

612
Satin Bronze

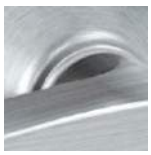
613
Oil Rubbed Bronze



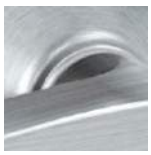
619
Satin Nickel

622
Matte Black

625
Bright Chrome



626
Satin Chrome



626AM
Satin Chrome, Antimicrobial

643e[1]
Aged Bronze

[1] e = an equivalent finish to the BHMA standard

ALLEGION™

Lever styles

Athens (ATH)
Athens with milled tactile warning (8AT)

Boardwalk (BRK)
Boardwalk with knurled tactile warning (8BK)

Broadway (BRW)
Broadway with knurled tactile warning (8BY)

Latitude (LAT)
Latitude with milled tactile warning (8LT)

Longitude (LON)
Longitude with milled tactile warning (8LN)

Omega (OME)

Rhodes (RHO)[1]
Rhodes with milled tactile warning (8RO)[1]

Sparta (SPA)
Sparta with milled tactile warning (8SP)

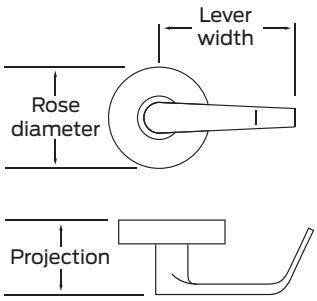
Tubular (TLR)
Tubular with knurled tactile warning (8TR)

Dimensions

Lever	Width	Projection
Athens (ATH)	4 9/16"	3 5/16"
Boardwalk (BRK)	4 15/16"	3 1/16"
Broadway (BRW)	4 1/2"	3 1/16"
Latitude (LAT)	4 1/2"	3 1/8"
Longitude (LON)	4 15/16"	3 1/8"
Omega (OME)	5 1/16"	3 5/16"
Rhodes (RHO)	4 9/16"	2 15/16"
Sparta (SPA)	4 15/16"	3 1/2"
Tubular (TLR)	4 15/16"	3"

Rose	Diameter
Standard	3 7/16"

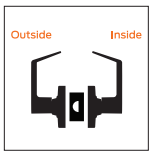
Return to door meets 1/2" requirement for Boardwalk (BRK), Longitude (LON), Omega (OME), Rhodes (RHO), Sparta (SPA) and Tubular (TLR) levers



[1] Optional break away lever available

ALLEGION

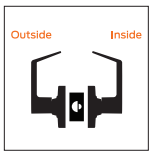
Mechanical non-keyed functions



Schlage ND10
ANSI F75

Passage latch

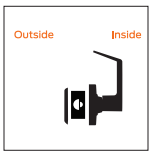
- Both levers always unlocked.
- Available with Request to Exit (RX) function.



Schlage ND12
ANSI F89

Exit lock

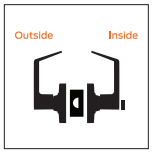
- Outside lever always fixed.
- Inside lever always free for immediate egress.
- Available with Request to Exit (RX) function.



Schlage ND25
ANSI -

Exit lock

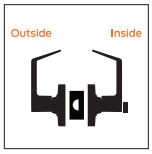
- Blank plate outside.
- Inside lever always free for immediate egress.



Schlage ND30
ANSI -

Patio lock

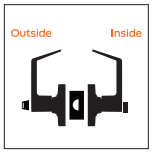
- Push button locking.
- Turning inside lever or closing door releases button, preventing a lock-out.
- Inside lever always free for immediate egress.



Schlage ND40
ANSI F76

Bath/bedroom privacy lock

- Push-button locking.
- Unlocked from outside with a small screwdriver.
- Turn inside lever or close door to release button.
- Inside lever always free for immediate egress.



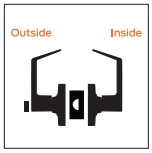
Schlage ND44
ANSI -

Hospital privacy lock

- Push-button locking.
- Unlocked from outside by turning emergency turn-button.
- Turn inside lever or close door to release button.
- Inside lever always free for immediate egress.

Key | Pushbutton | Turn/push button | Springlatch | Deadlatch

Mechanical non-keyed functions



Schlage **ND45**
ANSI **-**

Time out lock with Vandlgard

- Pushing and holding outside button disengages inside spindle, allowing inside lever to free-wheel without retracting latch.
- Release of outside button allows free egress from inside.

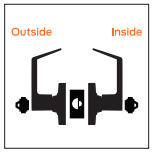
Schlage **ND170**
ANSI **-**

Single dummy trim

- Dummy trim for one side of door.
- Used for door pull or as matching inactive trim.

Key | Pushbutton | Turn/push button | Springlatch | Deadlatch

Mechanical keyed functions



Schlage ND93
ANSI F88

Vestibule lock with Vandlgard

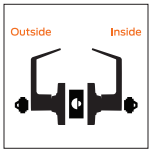
- Latch retracted by key from outside when outside lever is disengaged by key in inside lever.
- Vandlgard allows outside spindle to disengage from latch when locked.
- Inside lever always free for immediate egress.

Available with an optional indicator rose that clearly identifies key rotation direction for rapid lockdown. 626 finish only.

Schlage ND94
ANSI F84

Classroom lock with Vandlgard

- Outside lever disengaged and unlocked by key.
- Vandlgard allows outside spindle to disengage from latch when locked.
- Inside lever always free for immediate egress.

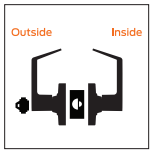


Schlage ND95
ANSI -

Classroom security lock

- Key in either lever locks or unlocks outside lever.
- Vandlgard allows outside spindle to disengage from latch when locked.
- Inside lever always free for immediate egress.

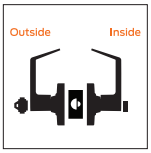
Comes standard with an indicator rose that clearly identifies key rotation direction for rapid lockdown. 626 finish only. Other finishes receive a standard rose.



Schlage ND96
ANSI F86

Storeroom lock with Vandlgard

- Outside lever always disengaged.
- Entrance by key only.
- Vandlgard allows outside spindle to disengage from latch when locked.
- Inside lever always free for immediate egress.
- Available with Request to Exit (RX) function.



Schlage ND97
ANSI F90

Corridor lock with Vandlgard

- Locked or unlocked by key from outside.
- Push-button locking from inside.
- Turning inside lever or closing door releases button.
- When outside lever is locked by key it can only be unlocked by key.
- Vandlgard allows outside spindle to disengage from latch when locked.
- Inside lever always free for immediate egress.


Key


Pushbutton

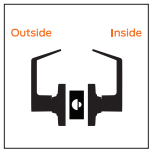

Turn/push button


Springlatch


Deadlatch

ALLEGION

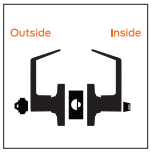
Wired electrified functions



Schlage ND12EL
ND12EU
ANSI -

Keyless electrified exit

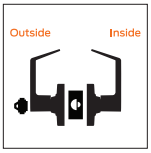
- Outside lever continuously locked (EL) or unlocked (EU) by 12-24V DC.
- EL is fail safe (power fail unlocks outside lever).
- EU is fail secure (power fail locks outside lever).
- Inside lever always free for immediate egress.
- Available with Request to Exit (RX) function.



Schlage ND80EL
ND80EU
ANSI -

Electrified storeroom

- Outside lever continuously locked (EL) or unlocked (EU) by 12-24V DC.
- EL is fail safe (power fail unlocks outside lever).
- EU is fail secure (power fail locks outside lever).
- Key outside serves as mechanical override.
- Inside lever always free for immediate egress.
- Available with Request to Exit (RX) function.



Schlage ND96EL
ND96EU
ANSI -

Electrified storeroom with Vandlgard

- Adds Vandlgard to ND80EL/EU.
- Vandlgard allows outside spindle to disengage from latch when locked, limiting the ability of vandals to apply excessive force to the chassis.
- Available with Request to Exit (RX) function.

Cylinders

Conventional cylinder	
P	6-pin Conventional (standard)
Z	SL 7-pin Conventional (A2 pinning)
L	Less Conventional
C	Less 6-pin Conventional double cylinder

Full size interchangeable core (FSIC)	
R	6-pin FSIC
M	SL 7-pin FSIC (A2 pinning)
J	Less FSIC
T	Refundable FSIC construction core

Small format interchangeable core (SFIC)	
G	7-pin SFIC (A2 pinning)
B	Less SFIC
BDC	Disposable SFIC construction core
H	Refundable SFIC construction core

Cylinders

Chassis	
Material	Modular design of zinc and steel components plated for corrosion protection
Door thickness	Standard: 1 5/8" to 2 1/8" Optional: 1 3/8" - 6" EE, EO, EI, ED configurations

Trim	
Handing	Non-handed
Levers	Pressure cast zinc, plated to match product finish specification
Roses	Wrought brass, bronze, or zinc, plated to match product finish specification

Latch	
Backset	Standard: 2 3/4" Optional: 2 3/8", 3 3/4", 7 3/4"
Faceplate	Standard : 1 1/8" x 2 1/4" Optional: 1" x 2 1/4" for 2 3/8" backset doors
Latch	Standard : 1/2" throw via Oil Impregnated Stainless Steel Optional : 3/4" throw anti-friction bolt available for pairs of doors
Strike	Standard: ANSI Curved Lip: 1 1/4" x 4 7/8" x 1 3/16" Optional: T Strike, ANSI strikes with alternative lip lengths, dust box options

Keying	
Cylinder format	6-pin Conventional (standard); also available in FSIC, SFIC and 7-pin SL cylinder formats plus less cylinder options designed to fit competitive cores from Sargent, Corbin Russwin, Yale and Medeco.
Keyway	Patented Everest 29 S123 (standard); also available in open, restricted, and Primus XP security levels with available master keying and construction keying.

Wired electrified	
Input Voltage	Autodetecting 12-24V DC, + 10%
Operating mode	Fail Safe or Fail Secure via switch on chassis
Current draw	0.23 amps maximum; 0.01 amps holding
Request to Exit	Modular - 3A @ 125VAC / 2A @ 30VDC

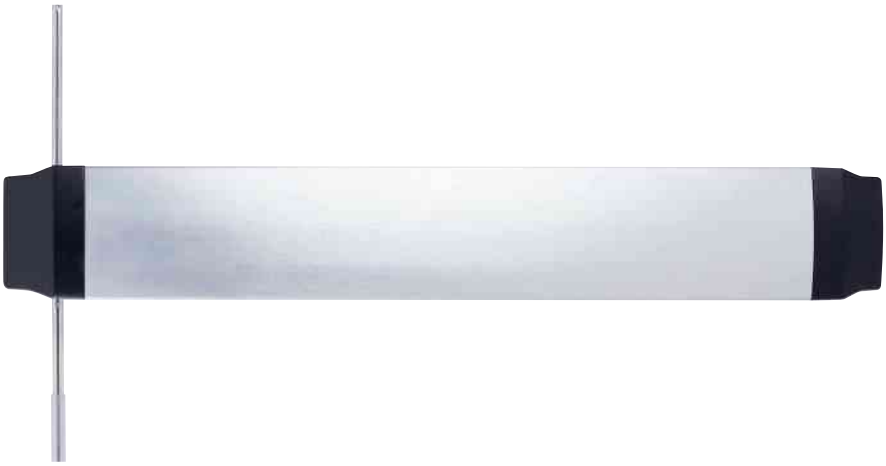
Warranty	
	10 years mechanical, 1 year wired electrified

Specifications

Certifications	
ANSI/BHMA	All ND Series comply with A156.2 performance requirements for grade 1 cylindrical locks. Wired electrified complies with A156.25 (indoor).
ICC	Complies with ICC A117.1 Accessible and Usable Buildings and Facilities
UL/cUL	All locks 3-hour A label single fire door 4'0" x 10'0"; pair doors 3-hour fire door 8'0" x 8'0" with 3/4" latch option; pair doors 90-minute fire door 8'0" x 10'0" with 3/4" latch option
CA Fire Code	All levers with a return to door of 1/2" (64 mm) or less comply (Rhodes, Sparta, Tubular, Omega, Longitude and Boardwalk)
FL Building Code	Complies with Florida Building Code (ASTM E330, E1886, E1996) and Miami Dade (TAS 201, 202, 203) requirements for hurricanes
Federal	Meets FF-H-106C Series 161; BAA compliant, all functions.

013158, Rev. 05/2019
www.allegion.com/us

9447/9547 INPACT™ Concealed vertical rod fire exit device




Top strike


Bottom strike


Top latch


Bottom latch

94/95 Inpact concealed vertical rod fire exit device for use on factory prepped steel doors, not available for wood doors. The Inpact device is UL listed for panic and fire, ANSI/BHMA 156.3 Grade 1. The Inpact device is non-handed.

Finishes – US3, US4, US10, US26, US28, 313.

Specifications

Device functions	Device ships EO, TL, L Blank escutcheon (BE) available
Device lengths	2'6" up to 2'9" for 24 5/32" device 2'10" up to 4' for 30 5/32" device
Device centerline from finished floor	39 5/8" (1006 mm)
Projection	1 5/8" (41 mm) neutral 1 1/4" (32 mm) depressed
Latchbolt	5/8" (16 mm) throw deadlocking latchbolt standard
Door undercut	1/4" (7 mm) maximum
Top & bottom latch case assembly	4 1/2" x 2 1/8" x 1 1/2" (114 mm x 54 mm x 38 mm)
Vertical rods	Two-piece adjustable rods, door 6'8" (2032 mm) to 8'0" (2540 mm) Can be adjusted by removing the latchside endcap
Fasteners	Included for surface mounting to recessed door prep and through bolting to trim
Electric options	**QEL** Quiet electric latch retraction **LX** Latchbolt monitor switch
Mechanical options	**LBR** Less bottom rod **PL** Pullman latch (with electric strike -ES)
Dogging option	No mechanical dogging
Strikes	Top - 338 unfinished, botom - 385A unfinished

QEL

Quiet electric latch retraction

- Bolt retraction via switch
- Converts exit door to push-pull operation

LX

Latchbolt monitor switch

- Signals use of an opening
- SPDT switch to monitor latch bolt

LBR

Less bottom rod

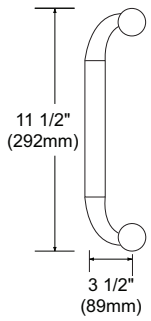
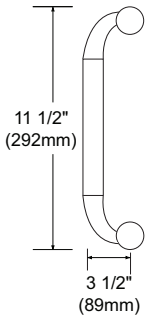
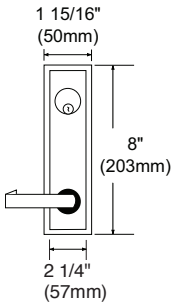
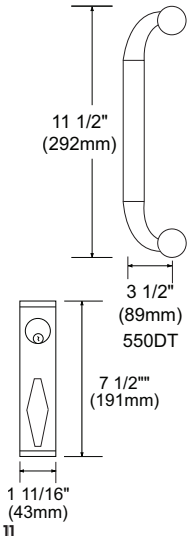
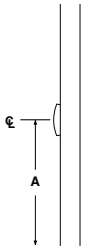
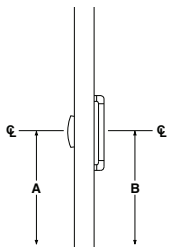
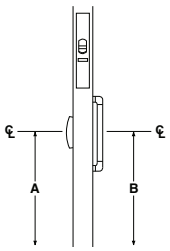
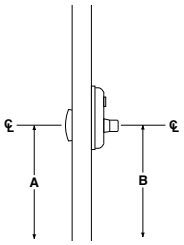
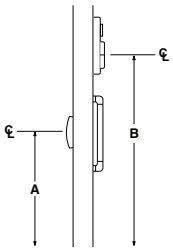
- Available with UL Fire Label
- For pairs of vertical rod devices

Standard trim

	EO **Exit only**	TL  **Thumbturn key** key locks & unlocks (use with DT trim)
Product description	9447EO -F 9547EO-F	9447TL-F 9547TL-F
Trim description	—	550DT x 376T
Escutcheon plate size	—	7 1/2" x 1 11/16" (190mm x 43mm)
Pull center to center	—	—
Projection/Offset	—	2 5/8" x 1 7/8" (67 mm x 48mm)
ANSI function	01	11 or 12
Cylinder type	—	1 1/4" Mortise
Handing	—	—

	L  **Lever** Key Locks & Unlocks	L-BE  **Lever - Blank Escutcheon** Always Operable (No Cylinder)	L-NL  **Lever-Night Latch** Unlocks Lever, Relocks Upon Key Removal
Product description	9447L-F 9547L-F	9447L-BE-F 9547L-BE-F	9447L-NL-F 9547L-NL-F
Trim description	940L	940L-BE	940L-NL
Escutcheon plate size	8" x 2 1/4" x 1 1/8" (203 x 57 x 29 mm)	8" x 2 1/4" x 1 1/8" (203 x 57 x 29 mm)	8" x 2 1/4" x 1 1/8" (203 x 57 x 29 mm)
Pull center to center	—	—	—
Projection	2 3/32" (75 mm)	2 3/32" (75 mm)	2 3/32" (75 mm)
ANSI function	08	14	03
Cylinder type	1 1/4" Mortise	—	1 1/4" Mortise
Handing	Handed/Reversible	Handed/Reversible	Handed/Reversible

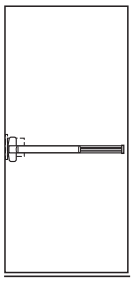
INPACT™ Trim selection

Trim number and dimensions			550DT 	550 DT x Cylinder 	940L 	550DT x 376T 
			01 Exit only	**02** Pull when dogged	**03** Key retracts latch bolt	**08** Key locks lever	**11** Key locks thumbturn
Device/Trim center line to finished floor							
Projection		—	2 5/8"	2 5/8"	3 1/8"	1 13/16" / 2 5/8"
Concealed vertical rod	Panic	9447EO 9547EO	9447DT 9547DT	— —	9447L 9547L	9447TL 9547TL
	Fire	9447EO-F 9547EO-F	— —	— —	9447L-F 9547L-F	9447TL-F 9547TL-F
	Ctr. line	39 5/8 (1006mm)	A 39 5/8 (1006mm) B 39 5/8 (1006mm)	— —	A 39 5/8 (1006mm) B 39 5/8 (1006mm)	A 39 5/8 (1006mm) B 53 1/2 (1359mm)
Mortise lock	Panic	9475EO 9575EO	9475DT 9575DT	9475NL 9575NL	9475L 9575L	— —
	Fire	9475EO-F 9575EO-F	— —	9475NL-F 9575NL-F	9475L-F 9575L-F	— —
	Ctr. Line	39 5/8 (1006mm)	A 39 5/8 (1006mm) B 39 5/8 (1006mm)	— —	A 39 5/8 (1006mm) B 39 5/8 (1006mm)	— —
Cylinder type required	Vert. rod device	—	—	—	Mortise*	Mortise*
	Mortise device	—	—	Mortise*	—	Mortise*

*See page 13 for cylinder information.

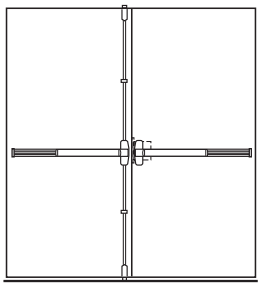
Popular applications and handling

Single door applications

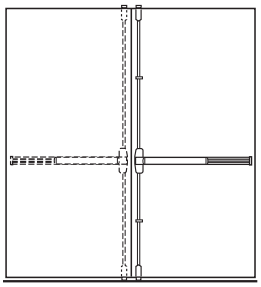


Single mortise lock device

Double door applications

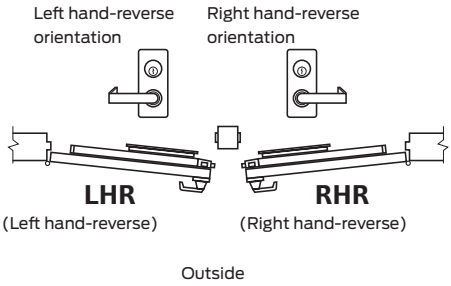


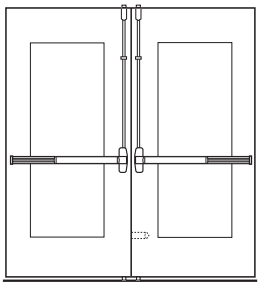
Mortise lock and surface mounted or concealed vertical rod device combination—same direction



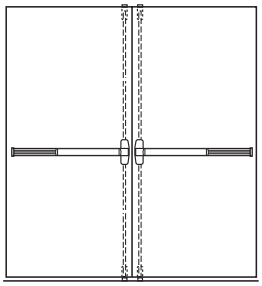
Two vertical rods—double egress

Door handing





Two Fire Exit Hardware vertical rods with auxilary fire latch-LBR option



Two concealed vertical rods

INPACT™ Trim operation

Standard trim

Lever 940L*

L

Forged brass 1 3/8" (35mm) depth escutcheon. #06 lever is standard. Optional lever designs are available.

* Blank escutcheon "BE" available. Example: 940L-BE.

Optional trim

Dummy Pull 550DT

DT

Heavy aluminum forged brackets with 10" (254mm) stainless steel pullbar.

Thumbturn 376T

TL

Forged brass 7/8" (22mm) escutcheon. It is often used with a 550DT pull trim.

Only available with concealed rod devices.

Lever styles

Decorative Levers

M51
Knurling available

M52
Knurling available

M53

M54

M55

M56

M57 ••

M61
(Handed)

M62 ••
(Handed)

M63
(Handed)

M81
Knurling available

M82

M83

M84

M85
(Handed)

•• Available in Stainless Steel substrate ONLY.

Standard Levers

01

02
Knurling available

03*
Knurling available

05

06*
Default lever
Knurling available

07

12
(Handed)

16
(Omega)

17*
Knurling available

18

ACC
(Accent)
(Handed)

AST
(Asti)
(Handed)

MER
(Merano)
(Handed)

STA
(St. Annes)
(Handed)

LAT*
Latitude

LON*
Longitude

*Available in Stainless Steel - specify SS when ordering

UL Listings, Fire exit hardware label / Opening size

UL Listed — fire exit hardware label/opening size

Exit device	Single door	Double door	
		Same direction**	Double egress
9475-F	3 Hour		
9575-F	4' x 10'		
9447-F		90 Minute	3 Hour
9547-F		8' x 10'	8' x 10'
9447LBR-F		90 Minute	3 Hour
9547LBR-F		8' x 10'	8' x 10'

Consult your door manufacturer for maximum listed door height.

Finishes

Finishes*

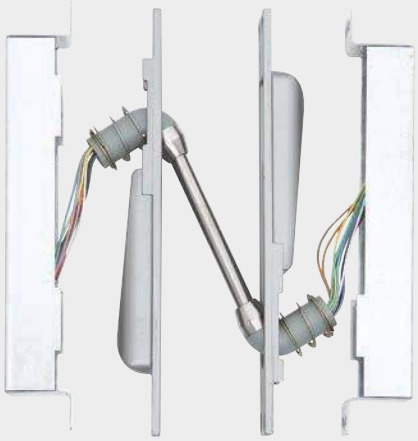
Color	US Number	BHMA Number
Chromium, polished	US26	625
Chromium, dull	US26D	626
Brass, polished	US3	605
Brass, dull	US4	606
Aluminum, anodized	US28	628
Duranodic dark bronze	313	710

*** Note**: Durable powder coated finishes available at specific special request. PLEASE CONTACT FACTORY.

ALLEGION

VON DUPRIN

Electrical power transfer



Overview

Electric power transfer provides a means of transferring electrical power from a door frame to the edge of a swinging door. The units are completely concealed when the door is in the closed position, and are ideally suited for installations involving abuse or heavy traffic.

Two models are available; EPT-2, two 18 gauge wires and EPT-10, ten 24 gauge wires.

Features and benefits

- UL Listed for use on fire doors
- UL listed as Miscellaneous Door Accessory
- Ball-and-socket joint construction provides cut and pinch protection for wiring
- Built for heavy traffic and high abuse openings

Door applications

- Up to 5" butt hinges – 180° swing.
- 5 1/2" butt hinges – 130° swing.
- 6" butt hinges – 110° swing.
- 3/4" offset pivots – 180° swing.

Not for use with swing clear hinges, center-hung pivots, pocket pivots or balanced doors.

Door applications shown are for 1 3/4" door thickness, for all other applications contact Technical Support to confirm compatibility.

Finishes

- SP28 (sprayed aluminum)
- SP313 (sprayed duranodic)

Dimensions

Housing	9" X 1 1/4 X 1 5/8 (229mm X 32mm X 38mm)
EPT-2	Two 18 gauge wires, up to 2 AMPS @ 24VDC, with a 16 AMPS maximum surge
EPT-10	Ten 24 gauge wires, up to 1 AMPS @ 24VDC, with a 16 AMPS maximum surge
PNT-1	5/32" tubing

To order, specify

- **EPT-2, EPT-10 or PNT-1.**
- **Finish, SP28 or SP313.**

About Allegion

Allegion (NYSE: ALLE) is a global pioneer in safety and security, with leading brands like CISA®, Interflex®, LCN®, Schlage® and Von Duprin®. Focusing on security around the door and adjacent areas, Allegion produces a range of solutions for homes, businesses, schools and other institutions. Allegion is a $2 billion company, with products sold in almost 130 countries. For more, visit **www.allegion.com.**

aptiQ ■ LCN ■ SCHLAGE ■ STEELCRAFT ■ VON DUPRIN

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010106, Rev. 04/16
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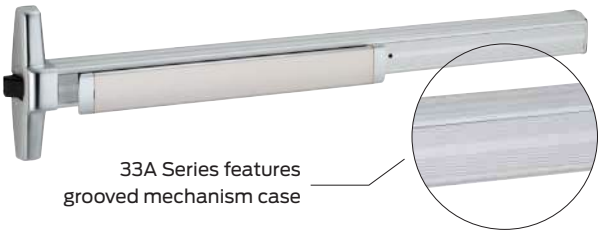
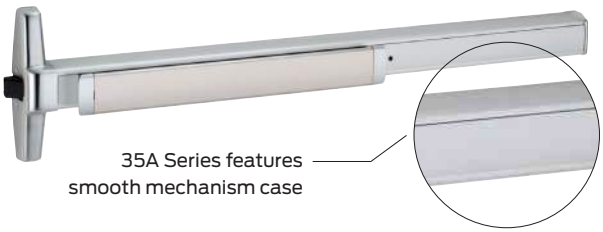
VON DUPRIN®

Exit devices

33A/35A Series





Overview

The 33A/35A Series is a narrow stile push pad device popular for its vast application coverage. With many field configurable and upgradeable solutions available, it's easy to enhance the functionality of an existing device. Mechanical and electronic options include quiet electric latch retraction, delayed and controlled egress, concealed vertical cables and security indicators. It's one way Von Duprin® protects its customers' investments long into the future.

Device types

Rim device

27A Surface mounted vertical rod device [1]

47A Concealed vertical rod device, 5/8" throw[1]

48A Concealed vertical rod device, 5/8" top, 1 1/2" bottom throw

49A Concealed vertical cable device [2]

50AWDC Concealed vertical cable wood door device

[1] Also available less bottom rod (LBR)
[2] Also available less bottom latch (LBL)

ALLEGION™

Finishes

605
Bright Brass

606
Satin Brass

612
Satin Bronze

619
Satin Nickel

622
Matte Black

625
Bright Chrome

626
Satin Chrome

626AM
Satin Chrome, Antimicrobial

628
Aluminum, Clear Anodized

630
Satin Stainless

630AM
Satin Stainless, Antimicrobial

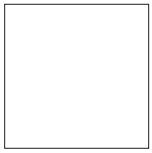
643e
Aged Bronze

693
Black

710
Dark Brown, Anodized

Due to the many variations in monitors and printers, color samples may appear different than the physical product. Contact your local sales representative for a physical color sample.

Trim functions



EO No outside trim

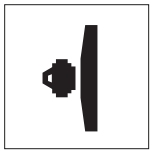
- Exit only

DT Dummy trim

- Pull when dogged (not recommended for fire device)

NL Night latch

- Key retracts latchbolt
- Rim cylinder

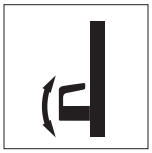


NLOP Night latch

- Key retracts latchbolt, optional pull required

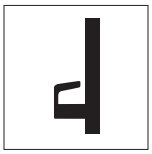
L Lever

- Key locks and unlocks
- 1 ¼" mortise cylinder
- Handed, reversible lever
- Electrified lever operation available



LBE Lever, blank escutcheon

- Always operable (no cylinder)



LDT Lever, dummy trim

- Pull when dogged

T Thumbturn

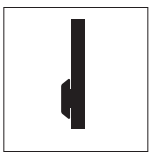
- Key locks and unlocks
- 1 ¼" mortise cylinder

TBE Thumbturn, blank escutcheon

- Blank escutcheon always operable (no cylinder)

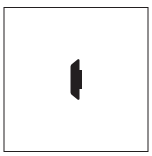
TL Turn lever

- Key locks and unlocks (use with DT trim)
- 1 ¼" mortise cylinder



TLBE Turn lever, blank escutcheon

- Blank escutcheon always operable (no cylinder, use with DT trim)



TLOP Turn lever, optional pull

Trim styles


386


388


360L


360T


374T x 386DT


374T/376T x 8190 10"


388 x 550DT


360T x 550DT


388 x 8190 10"


360T x 8190 10"


392-6

Trim styles

Dimensions

Trim style	Base width	Base height	Projection	Grip width	Grip height
386/ 386DT	1 5/8"	7 15/32"	2 7/16"	4 5/16"	8 1/2"
388	1 11/16"	7 15/32"	1"		
360L	1 11/16"	7 1/2"	3"		
360T	1 11/16"	7 1/2"	1 13/16"		
374T	1 11/16"	7 1/2"			
376T	1 11/16"	7 1/2"	1 13/16"		
550DT	3 5/8"	11 9/16" (10" center to center)	1 7/8"		
8190 10"	3 1/4"	11"	3 1/4"		
392-6	3 1/2"	7" (6 1/4" center to center)	2 1/4"		

Lever styles

Standard levers

01

02
- Knurling available

03
- Knurling available

05

06
- Default lever
- Suites with Schlage Rhodes
- Knurling available

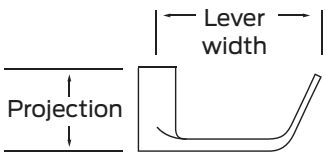
07
- Suites with Schlage Athens

12
- Handed

16
- Suites with Schlage Omega

Dimensions

Lever	Width	Projection
01	4.0"	2.1"
02	4.75"	2.3"
03	4.75"	2.813"
05	3.75"	2.8"
06	4.7"	2.1"
07	4.6"	2.3"
12	4.3"	2.9"
16	5.05"	2.66"



Electromechanical device options

Switches

LX **Latchbolt monitoring**

LX-LC **Latchbolt monitoring, low current**
- Signals use of an opening
- SPDT switch to monitor latch bolt
- 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option

RX **Request to exit**

RX-LC **Request to exit - low current**

RX-2 **Double request to exit - 2 RX switches**

WP-RX **Waterproof request to exit**
- Signals use of an opening
- SPDT switch to monitor pushpad
- 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option

LX-RX **Request to exit/latchbolt monitoring combination**

LX-RX-LC **Request to exit/latchbolt monitoring combination, low current**
- 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option

SS **Signal switch**
- Monitors pushpad and latchbolt
- Signals unauthorized use of an opening
- Switch makes latch bolt tamper-resistant
- Up to 2.0 A @ 24VDC

Latch retraction

EL **Electric latch retraction**
- Enables remote unlatching
- Alternative to manual dogging
- Voltage: 24VDC (continuous duty)
- Current: 16.0 A inrush / 0.3 A holding

QEL **Quiet electric latch retraction**

HD-QEL **Quiet electric latch retraction with hex dogging**
- Bolt retraction via switch
- Converts exit door to push-pull operation
- Voltage: 24VDC
- Current: 1.0 A inrush (0.5 sec.) / 0.14 A holding

Delayed egress

CX **Chexit delayed exit**
- Meets NFPA 101 requirements
- Self-contained controls, locking, alarm
- Input voltage: 24VDC
- Input current inrush: 1.25 A
- Input current holding: 390 mA
- Alarm relay and secure relay contact ratings: 24 VDC, 1 A

CX-RCM **Chexit remote module**
- Chexit for smaller doors that can not accommodate a standard Chexit device
- Size: 3.75” x 5.57” x 2.50”
- Input voltage: 24VDC
- Input current inrush: 1.25A
- Input current holding: 390mA
- Alarm relay and secure relay contact ratings: 24 VDC, 1 A

Miscellaneous

ALK **Alarm exit kit**
- Unauthorized opening triggers 85-decibel horn
- Set in armed or disarmed mode by key
- Assembly includes both a 24VDC input and external inhibit

CON **Allegion Connect**
- Common connectors to connect various door hardware all the way to the power supply

E360 **Electric locking and unlocking trim**
- Remains latched while unlocked
- Remote electrical control
- Voltage: 24VDC (Continuous Duty)
- Current: 0.22 amps

Electromechanical device options

Matrix shows available options per device type but does not represent compatibly across multiple options.

	Switches									Latch retraction			Delayed egress		Misc		
	LX	LX-LC	RX	RX-LC	RX-2	WP-RX	LX-RX	LX-RX-LC	SS	EL	QEL	HD-QEL	CX	CX-RCM	ALK	CON	E360
33A 35A	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
33A-F 35A-F	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■
3327A 3527A	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3327A-F 3527A-F	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■
3347A 3547A	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3347A-F 3547A-F	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■
3348A 3548A	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3348A-F 3548A-F	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■
3349A 3549A	■[1]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3349A-F 3549A-F	■[1]	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■
3350AWDC 3550AWDC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3350AWDC-F 3550AWDC-F	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■

[1] For 3349A/3549A devices, LX switch monitors trim input or electric dogging of EL/QEL devices. LX switch does not monitor latchbolt condition.

Mechanical device options

Dogging

CD — **Cylinder dogging, panic only**

LD — **Less dogging**

CDSI — **Cylinder dogging with indicator**
- Provides visible lock/unlock indicators showing whether device is dogged or undogged

HDSI — **Hex dogging with indicator**
- Provides visible lock/unlock indicators showing whether device is dogged or undogged

Environmental

PN — **Pneumatic latch retraction**
- For areas where electrical devices banned
- Special linkage for mechanical or pneumatic dogging

QM — **Quiet mechanical option**
- Provides damper-controlled relatching of device

INS — **Insulclad kits**
- Kits with longer fasteners or parts for Insulclad doors

AM — **Anti-microbial finish**

Weatherized

WH — **Weep holes**
- Drainage (weep) holes in mechanism case

California code

AX — **Accessible device**
- UL certified to meet new 5 lb. maximum operating force requirement
- Exceeds ANSI/BHMA requirements

Latches

PL — **Pullman latch**
- Latches are always extended
- Most commonly used in conjunction with electric strikes and LBR-less bottom rod application

Touch bar trim

RSS — **Red silk screen**
- Red silk-screened lettered touchbar trim

PUSH — **PUSH**
- Touchbar trim embossed PUSH

SG — **Safety glow**
- Self-illuminating touchpad
- Glows brightly during low or no light conditions

KN — **Knurled touchbar**
- Tactile warning applied to device

BRAILLE — **Braille**
- Vision impaired touchpad
- Raised letter and Braille

Mechanical device options

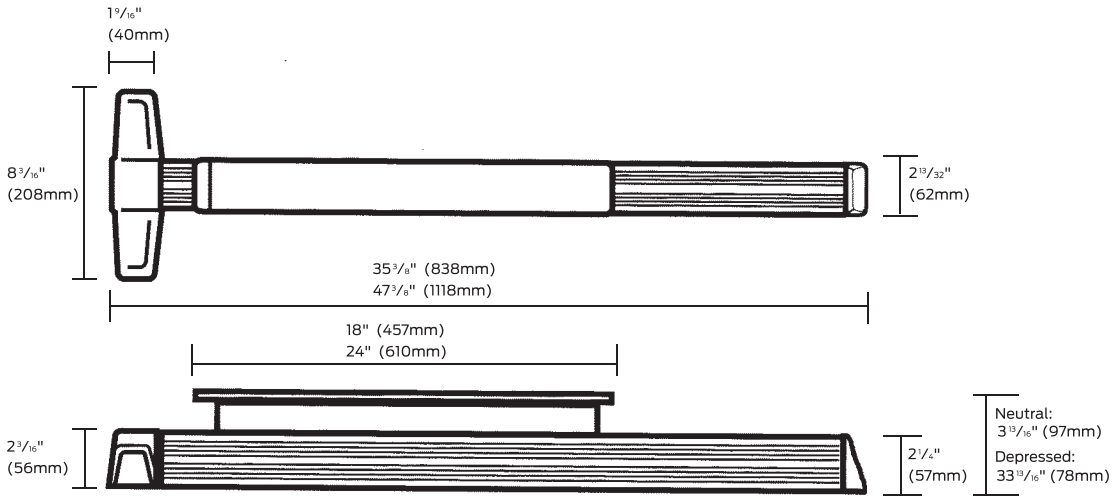
Matrix shows available options per device type but does not represent compatibly across multiple options.

	Dogging				Environmental				Weatherized	CA code	Latches	Touch bar trim				
	CD	LD	CDSI	HDSI	PN	QM	INS	AM	WH	AX	PL	RSS	PUSH	SG	KN	BRAILLE
35A 33A	■	■	■	■	■	■		■	■	■		■	■	■	■	■
35A-F 33A-F					■	■		■	■	■		■	■	■	■	■
3527A 3327A	■	■	■	■	■	■		■	■		■	■	■	■	■	■
3527A-F 3327A-F					■	■		■	■			■	■	■	■	■
3547A 3347A	■	■	■	■	■		■	■	■		■	■	■	■	■	■
3547A-F 3347A-F					■			■	■			■	■	■	■	■
3548A 3348A	■	■	■	■	■			■	■			■	■	■	■	■
3548A-F 3348A-F					■			■	■			■	■	■	■	■
3549A 3349A	■	■	■	■	■		■	■	■	■ LBL		■	■	■	■	■
3549A-F 3349A-F					■			■	■	■ LBL		■	■	■	■	■
3550A-WDC 3350A-WDC	■	■	■	■	■			■	■			■	■	■	■	■
3550A-WDC-F 3350A-WDC-F					■			■	■			■	■	■	■	■

Specifications

Accessibility	▪ Force to depress push pad – AX device: 5 lbs – Standard device: 15 lbs ▪ Push pad projection – Neutral: 3 13/16" (97 mm) – Depressed: 3 1/16" (78 mm)
Certifications/ approvals	All Von Duprin 33A and 35A exit devices are ANSI/BHMA Certified. Please refer to the BHMA Certified Products Directory for specific listings.
Mounting height	39 13/16" (1011 mm) 39 11/16" (1008 mm) with mullion
Warranty	36 months from the date of placing the product in operation

Dimensions



013234, Rev. 09/2019
www.allegion.com/us

ALLEGION™

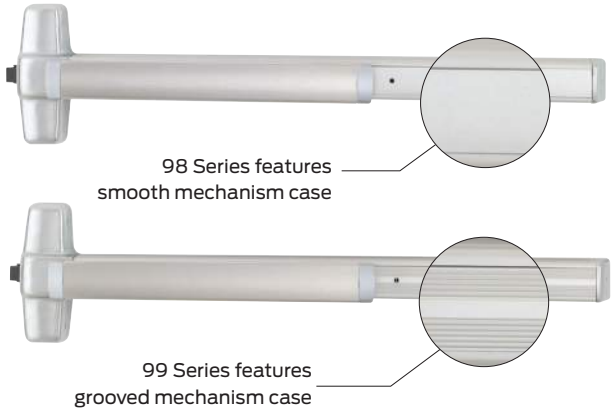
VON DUPRIN®

Exit device

98/99 Series

Overview

The 98/99 Series devices are heavy-duty push pads. The 98 Series has a smooth mechanism case, while the 99 Series has a grooved mechanism case. The 98/99 Series has been certified to the highest industry standards and are used in schools, hospitals and government buildings.



Device types

Rim device

75 Mortise lock device

27 Surface mounted vertical rod device [1]

47 Concealed vertical rod device, 5/16" throw [1]

48 Concealed vertical rod device, 5/8" top, 1 1/2" bottom throw

47WDC Concealed vertical rod wood door device [1]

49 Concealed vertical cable device [2]

50WDC Concealed vertical cable wood door device

57 Three-point latch device

[1] Also available less bottom rod (LBR)
[2] Also available less bottom latch (LBL)

ALLEGION™

VON DUPRIN®

Exit device
98/99 Series

Finishes

605
Bright Brass

606
Satin Brass

612
Satin Bronze

619
Satin Nickel

622
Matte Black

625
Bright Chrome

626
Satin Chrome

626AM
Satin Chrome, Antimicrobial

628
Aluminum, Clear Anodized

630
Satin Stainless

630AM
Satin Stainless, Antimicrobial

643e
Aged Bronze

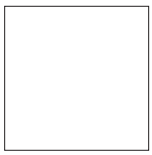
693
Black

710
Dark Brown, Anodized

Due to the many variations in monitors and printers, color samples may appear different than the physical product. Contact your local sales representative for a physical color sample.

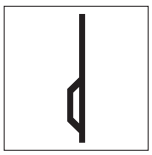
ALLEGION™

Trim functions



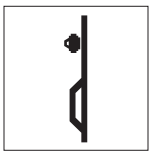
EO **No outside trim**

- Exit only



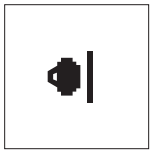
DT **Dummy trim**

- Pull when dogged (not recommended for fire device)



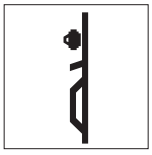
NL **Night latch**

- Key retracts latchbolt
- Rim and 1 ¼" mortise cylinder



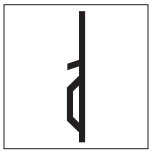
NLOP **Night latch**

- Key retracts latchbolt, pull required



TP **Thumbpiece**

- Key locks and unlocks
- Rim and 1 ¼" mortise cylinder



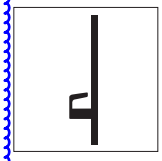
TPBE **Thumbpiece, blank escutcheon**

- Blank escutcheon always operable (no cylinder, use with DT trim)

L **Lever**

K **Knob**

- Key locks and unlocks
- Rim and 1 ¼" mortise cylinder
- Handed, reversible lever
- Electrified lever operation available



LDT **Lever, dummy trim**

KDT **Knob, dummy trim**

- Pull when dogged

LNL **Lever, night latch**

KNL **Knob, night latch**

- Key retracts latchbolt
- Rim and 1 ¼" mortise cylinder
- Handed, reversible lever

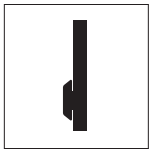
LBE[1] **Lever, blank escutcheon**

KBE **Knob, blank escutcheon**

- Always operable (no cylinder)

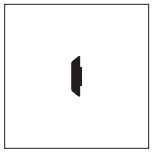
TL **Turn lever**

- Key locks and unlocks (use with DT trim)
- 1 ¼" mortise cylinder



TLBE **Turn lever, blank escutcheon**

- Blank escutcheon always operable (no cylinder, use with DT trim)



TLOP **Turn lever, optional pull**

HL **Hospital latch**

- Key locks and unlocks
- 1 ¼" mortise cylinder

Trim styles

990

996

696

697
3/4" (19mm) diameter pull

392-7

HL

374

VR910

VR914

Dimensions

Trim style	Width	Height	Thickness	Projection
990	3"	14 3/16"	3/32"	2"
996 Knob	2 3/4"	10 3/4"	27/32"	3 1/4"
996 Lever	2 3/4"	10 3/4"	27/32"	2 7/8"
696	1 5/8"	13 1/2"	3/16"	2 1/6"
697	1 5/8"	13 1/2"	3/16"	3"
392-7	3/4" inch round stainless steel with 7" center to center that matches the 98/99 center case. 3 1/2" offset with 1 1/2" clearance.			
HL	2 9/16"	7 7/8"	-	2 5/8"
374	2 3/4"	10 3/4"	27/32"	
VR910/914 with RIM/verticals	5 1/2"	11"	-	
VR910/914 with mortise	7 1/4"	11"	-	

Lever styles

Standard levers

01

02
- Knurling available

03
- Knurling available

05

06
- Default lever
- Suites with Schlage Rhodes
- Knurling available

07
- Suites with Schlage Athens

12
- Handed

16
- Suites with Schlage Omega

Dimensions

Lever	Width	Projection
01	4.0"	2.1"
02	4.75"	2.3"
03	4.75"	2.813"
05	3.75"	2.8"
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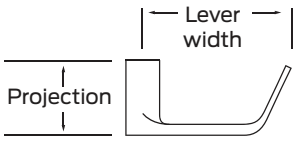
07	4.6"	2.3"
12	4.3"	2.9"
16	5.05"	2.66"



Electromechanical device options

Switches

LX **Latchbolt monitoring**

LX-LC **Latchbolt monitoring, low current**
- Signals use of an opening
- SPDT switch to monitor latch bolt
- 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option

RX **Request to exit**

RXLC **Request to exit - low current**

RX2 **Double request to exit - 2 RX switches**

WP-RX **Waterproof request to exit**

RX-AUX **RX to RX-2 conversion**
- Signals use of an opening
- SPDT switch to monitor pushpad
- 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option

LX-RX **Request to exit/latchbolt monitoring combination**

LX-RX-LC **Request to exit/latchbolt monitoring combination, low current**
- 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option

SS **Signal switch**
- Monitors pushpad and latchbolt
- Signals unauthorized use of an opening
- Switch makes latch bolt tamper-resistant
- Up to 2.0 A @ 24VDC

Latch retraction

EL **Electric latch retraction**

SD-EL **Electric latch retraction with special center case dogging**
- Enables remote unlatching
- Alternative to manual dogging
- Voltage: 24VDC (continuous duty)
- Current: 16.0 A inrush / 0.3 A holding

QEL **Quiet electric latch retraction**

HD-QEL **Quiet electric latch retraction with hex dogging**

SD-QEL **Quiet electric latch retraction with special center case dogging**
- Bolt retraction via switch
- Converts exit door to push-pull operation
- Voltage: 24VDC
- Current: 1.0 A inrush (0.5 sec.) / 0.14 A holding

Delayed egress

CX **Chexit delayed exit**
- Meets NFPA 101 requirements
- Self-contained controls, locking, alarm
- Input voltage: 24VDC
- Input current inrush: 1.25 A
- Input current holding: 390 mA
- Alarm relay and secure relay contact ratings: 24 VDC, 1 A

CX-RCM **Chexit remote module**
- Chexit for smaller doors that can not accommodate a standard Chexit device
- Size: 3.75” x 5.57” x 2.50”
- Input voltage: 24VDC
- Input current inrush: 1.25A
- Input current holding: 390mA
- Alarm relay and secure relay contact ratings: 24 VDC, 1 A

Miscellaneous

ALK **Alarm exit kit**
- Unauthorized opening triggers 85-decibel horn
- Set in armed or disarmed mode by key
- Assembly includes both a 24VDC input and external inhibit

Electromechanical device options

CON — **Allegion Connect**

- Common connectors to connect various door hardware all the way to the power supply

E996 — **Electric locking and unlocking trim**

M996

- Remains latched while unlocked
- Remote electrical control
- Voltage: 24VDC (Continuous Duty)
- Current: 0.22 amps

E7500 — **Electric mortise lock device**

- Voltage: 12 or 24VDC
- Current: 0.60 amps @ 12VDC, 0.30 amps @ 24VDC

Electromechanical device options

Matrix shows available options per device type but does not represent compatibly across multiple options.

	Switches									Latch retraction					Delayed egress		Misc			
	LX	LX-LC	RX	RXLC	RX2	WP-RX	LX-RX	LX-RX-LC	SS	EL	SD-EL	QEL	HD-QEL	SD-QEL	CX	CX-RCM	ALK	CON	E996	Mortise
98 99	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
98F 99F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
XP98 XP99		■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	
XP98-F XP99-F		■	■	■	■	■	■	■		■		■			■	■	■	■	■	
9875 9975			■	■	■	■			■	■	■	■	■	■	■	■	■	■	■	■
9875-F 9975-F			■	■	■	■			■	■		■			■	■	■	■	■	■
9827 9927	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9827-F 9927-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9857 9957	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9857-F 9957-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9847 9947	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9847-F 9947-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9848 9948	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9848-F 9948-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9849 9949	■[1]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9849-F 9949-F	■[1]	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9847WDC 9947WDC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9847WDC-F 9947WDC-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9850WDC 9950WDC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9850WDC-F 9950WDC-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	

[1] For 98/9949 devices, LX switch monitors trim input or electric dogging of EL/QEL devices. LX switch does not monitor latchbolt condition.

Mechanical device options

Dogging

CD — **Cylinder dogging, panic only**

CD-CX — **Center case cylinder dogging for Chexit devices**

CI — **Cylinder dogging indicator**
- Battery-operated dogging indicator in cylinder format with red light visible from over 75 feet away

DI — **Dogging indicator**
- Battery-operated dogging indicator in hex format with red light visible from over 75 feet away

LD — **Less dogging**

SD — **Special center case dogging**
- Center case cylinder dogging

Classroom security

-2 — **Double cylinder**
- Inside key cylinder locks/unlocks outside trim

-2SI — **Double cylinder with security indicator**
- Inside key cylinder locks/unlocks outside trim with visible indicators that provide status of door

CDSI — **Cylinder dogging with indicator**
- Provides visible lock/unlock indicators showing whether device is dogged or undogged

HDSI — **Hex dogging with indicator**
- Provides visible lock/unlock indicators showing whether device is dogged or undogged

Environmental

PN — **Pneumatic latch retraction**
- For areas where electrical devices banned
- Special linkage for mechanical or pneumatic dogging

QM — **Quiet mechanical option**
- Provides damper-controlled relatching of device

INS — **Insulclad kits**
- Kits with longer fasteners or parts for Insulclad doors

AM — **Anti-microbial finish**

Weatherized

WH — **Weep holes**
- Drainage (weep) holes in mechanism case

WS — **Windstorm**
- Severe weather certified/tested
- FEMA and ICC compliant
- Tornado and hurricane tested

California code

AX — **Accessible device**
- UL certified to meet new 5 lb. maximum operating force requirement
- Exceeds ANSI/BHMA requirements

Latches

PL — **Pullman latch**
- Latches are always extended
- Most commonly used in conjunction with electric strikes and LBR-less bottom rod application

Mechanical device options

Touch bar trim

RSS — **Red silk screen**
- Red silk-screened lettered touchbar trim

PUSH — **PUSH**
- Touchbar trim embossed PUSH

SG — **Safety glow**
- Self-illuminating touchpad
- Glows brightly during low or no light conditions

KN — **Knurled touchbar**
- Tactile warning applied to device

BRAILLE — **Braille**
- Vision impaired touchpad
- Raised letter and Braille

Mechanical device options

Matrix shows available options per device type but does not represent compatibly across multiple options.

	Dogging						Classroom security				Environmental				Weatherized		CA code
	CD	CD-CX	CI	DI	LD	SD	-2	-2SI	CDSI	HDSI	PN	QM	INS	AM	WH	WS	AX
98 99	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■
98F 99F							■	■			■	■		■	■		■
XP98 XP99	■	■	■	■	■	■	■	■	■	■				■	■		■
XP98-F XP99-F							■	■						■	■		■
9875 9975	■	■	■	■	■	■	■		■	■	■			■	■		
9875-F 9975-F							■				■			■	■		
9827 9927	■	■	■	■	■	■			■	■	■	■		■	■	■	■ LBR
9827-F 9927-F											■	■		■	■	■	■ LBR
9857 9957	■	■	■	■	■	■			■	■	■			■	■	■	
9857-F 9957-F											■			■	■	■	
9847 9947	■	■	■	■	■	■			■	■	■		■	■	■		■ LBR
9847-F 9947-F											■			■	■		■ LBR
9848 9948	■	■	■	■	■	■			■	■	■			■	■		
9848-F 9948-F											■			■	■		
9849 9949	■	■	■	■	■	■			■	■	■		■	■	■		■ LBL
9849-F 9949-F											■			■	■		■ LBL
9847WDC 9947WDC	■	■	■	■	■	■			■	■	■			■	■		
9847WDC-F 9947WDC-F											■			■	■		
9850WDC 9950WDC	■	■	■	■	■	■			■	■	■			■	■		■ LBL
9850WDC-F 9950WDC-F											■			■	■		■ LBL

Mechanical device options

Matrix shows available options per device type but does not represent compatibly across multiple options.

	Latches	Touch bar trim				
	PL	RSS	PUSH	SG	KN	BRAILLE
98 99		■	■	■	■	■
98F 99F		■	■	■	■	■
XP98 XP99		■	■	■	■	■
XP98-F XP99-F		■	■	■	■	■
9875 9975		■	■	■	■	■
9875-F 9975-F		■	■	■	■	■
9827 9927	■	■	■	■	■	■
9827-F 9927-F		■	■	■	■	■
9857 9957		■	■	■	■	■
9857-F 9957-F		■	■	■	■	■
9847 9947	■	■	■	■	■	■
9847-F 9947-F		■	■	■	■	■
9848 9948		■	■	■	■	■
9848-F 9948-F		■	■	■	■	■
9849 9949		■	■	■	■	■
9849-F 9949-F		■	■	■	■	■
9847WDC 9947WDC		■	■	■	■	■
9847WDC-F 9947WDC-F		■	■	■	■	■
9850WDC 9950WDC		■	■	■	■	■
9850WDC-F 9950WDC-F		■	■	■	■	■

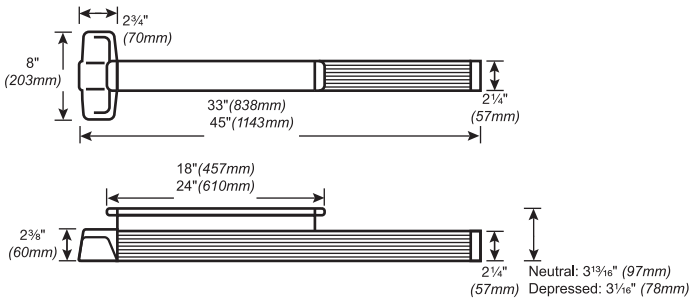
VON DUPRIN®

Exit device
98/99 Series

Specifications

Accessibility	▪ Force to depress push pad – AX device: 5 lbs – Standard device: 15 lbs ▪ Push pad projection – Neutral: 3 13/16" (97 mm) – Depressed: 3 1/16" (78 mm)
Certifications/ approvals	All Von Duprin 98/99 exit devices are ANSI/BHMA Certified. Please refer to the BHMA Certified Products Directory for specific listings.
Mounting height	39 13/16" (1011 mm) 39 11/16" (1008 mm) with mullion
Warranty	36 months from the date of placing the product in operation

Dimensions



013139, Rev. 11/2019
www.allegion.com/us

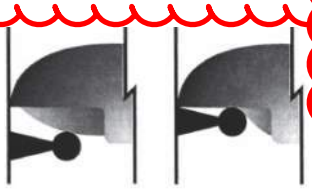
ALLEGION™

Mechanical options

AX Accessible device

The AX device is a UL certified exit device designed to meet the progressive requirements of the California Building Code for accessible openings. This device meets the 5 lbs of operating force requirement called for in chapter 11B-309.4. The AX device also exceeds ANSI/BHMA requirements. Available devices include: AX98/99, AX98/99-F, AX98/9949LBL, AX98/9949-F LBL, AX98/9949-F LBLAFL. Additionally, all AX devices will be shipped with a new UL label clearly stating “Meets California building Code (2013) Sec. 11B-309.4” and an “AX” identifier label on device center case. See images below for reference.

XP Extra performance



For increased security the XP98/99 Rim exit device has a static load force resistance of more than 2,000 pounds, twice that of standard rim exit devices. The two-piece latch bolt forms a 90° latch-to-strike contact. The “smart” latch changes shape when subjected to external forces. This design enables the exit door to withstand an external attack and remain secure. Additionally, the patented latch bolt design provides a greater, longer-lasting latch bolt to strike contact which is not easily affected by the twisting motion of a weakened frame, resulting in an opening that will remain strong.

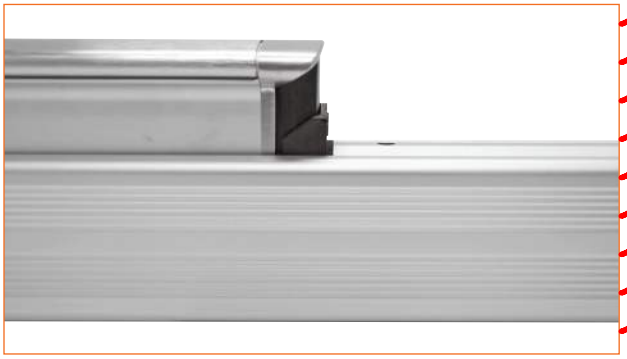
With a door loaded to 250 pounds, XP98/99 requires less than 40 pounds of pressure to open, 25% less than the safety code requires.

XP98/99 is available for panic or fire exit hardware applications. Dimensions, finishes and trim options are equal to the standard 98/99 series rim exit device.

Note: The 909 strike is to be used for all applications.
The exception occurs with the use of fire rated double door applications, in this instance the 954 strike is required.

PA Pushpad armor

Built to absorb impact, the pushpad armor stands up to the wear and tear of demanding high-traffic areas. This composite accessory provides added support, while protecting the pushpad on the hinge side of the device. Available for 33A/35A and 98/99 series exit devices. See images below for reference.

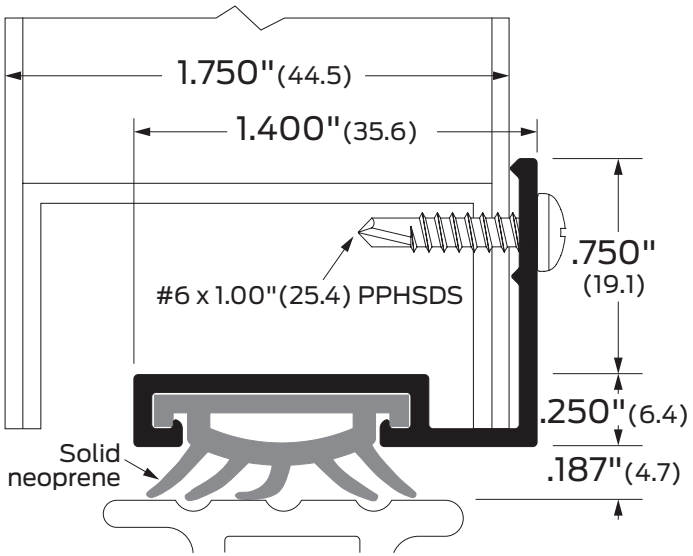


2720 Tobey Drive, Indianapolis, IN 46219
Tel 1-877-671-7011 ▪ Fax 800-851-0000
Zero.Customer.Support@allegion.com
www.zerointernational.com

Part No:	Part description:
153	Door shoe

Notes:	Provided by:	
Customer name:	Job no:	Date:

Image may not be shown to scale



Certifications:

Fire rated-UL10c

ANSI/BHMA:

153A, 153BK, 153D, 153G R3B414

BHMA CERTIFIED

Finishes:

A	Aluminum mill finish
BK	Aluminum black anodized
D	Aluminum dark bronze anodized
G	Aluminum gold anodized

Options:

SEC	Security screws

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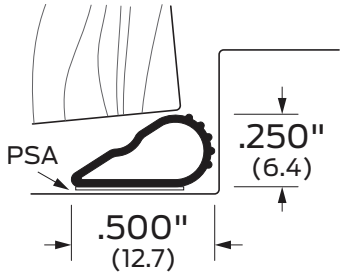
www.zerointernational.com

Part No:	Part description:
188S	Self-adhesive weatherstripping

Notes:	Provided by:	
Customer name:	Job no:	Date:

Image may not be shown to scale



Notes:
PSA standard. 20-minute fire rating.

Certifications:

- Fire rated-UL10c
- Smoke and draft control
- Air Infiltration
- Sound

ANSI/BHMA:

188S R0E151

BHMA CERTIFIED

Finishes:

BK	Black
BR	Brown
CL	Clear
GY	Gray
WH	White

Options:

ZAG	Ligature resistant gasketing

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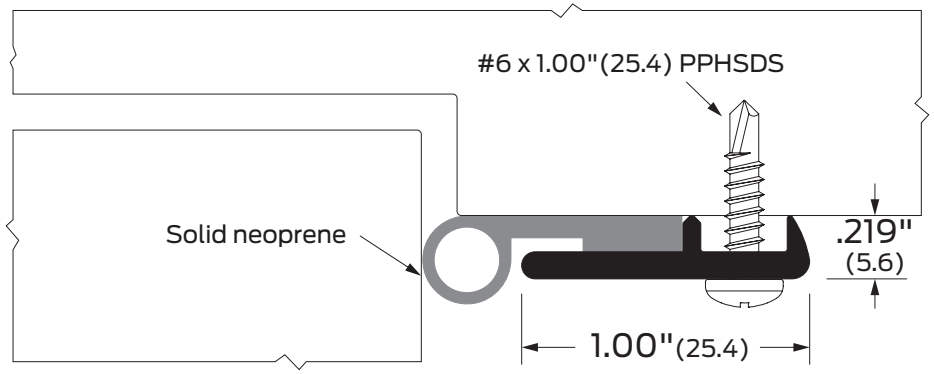
www.zerointernational.com

Part No:	Part description:
328	Head & jamb gasketing, door sweep, meeting stile

Notes:	Provided by:	
Customer name:	Job no:	Date:

Image may not be shown to scale



Notes:
ZAG option for mental health applications includes security screws

Certifications:

- Fire rated-UL10c
- Smoke and draft control (as head & jamb, door sweep)
- Air Infiltration (as head & jamb)
- Sound

ANSI/BHMA:

328AA, 328BK, 328D, 328G — R3B164 , R3B434, R3B735
328B — R1B164, R3B434

BHMA CERTIFIED

Finishes:

AA	Aluminum clear anodized
BK	Aluminum black anodized
D	Aluminum dark bronze anodized
G	Aluminum gold anodized
B	Bronze, architectural mill finish
B-ORB	Oil-rubbed bronze

Options:

ZAG	Ligature resistant gasketing
S	Order as a set
SEC	Security screws

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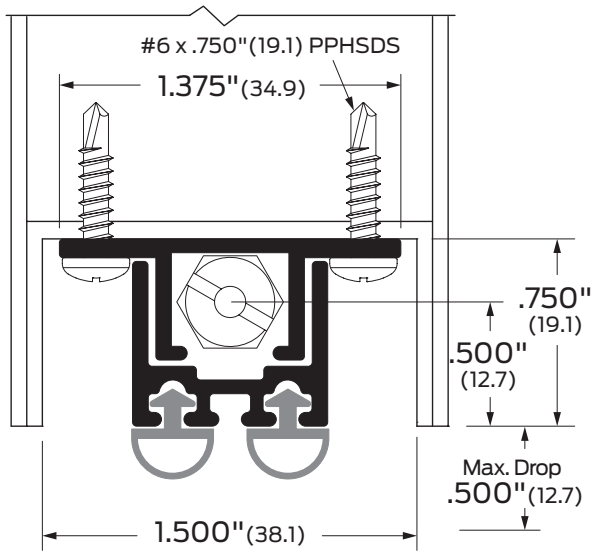
Zero.Customer.Support@allegion.com
www.zerointernational.com

Part No:	Part description:
355	Automatic door bottom Regular duty

Notes:	Provided by:	
Customer name:	Job no:	Date:

Image may not be shown to scale



Notes:
For use with hollow metal doors. Mortised. Supplied without end caps.

Certifications:

- Fire rated-UL10c
- Air Infiltration
- Sound

ANSI/BHMA:

355A R3E3241

BHMA CERTIFIED

Finishes:

AA	Aluminum clear anodized

Options:

FLO	Air flow/sound block
PL	Pull out
NH	No holes

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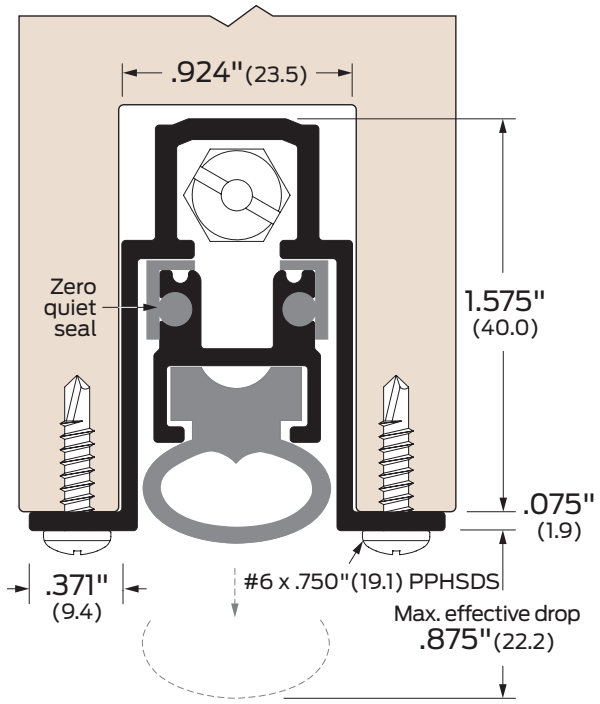
Zero.Customer.Support@allegion.com
www.zerointernational.com

Part No:	Part description:
364	Automatic door bottom Heavy duty

Notes:	Provided by:	
Customer name:	Job no:	Date:

Image may not be shown to scale



Notes:
Mortised. Supplied with solid neoprene extrusion.
Consult your local AHJ for maximum allowable door undercut.

Certifications:

- Fire rated-UL10c
- Sound

ANSI/BHMA:

364AA R3B3241

BHMA CERTIFIED

Finishes:

AA	Aluminum clear anodized

Options:

LS	Light spring
Z49	Removable end cap
PL	Pull out
NH	No holes

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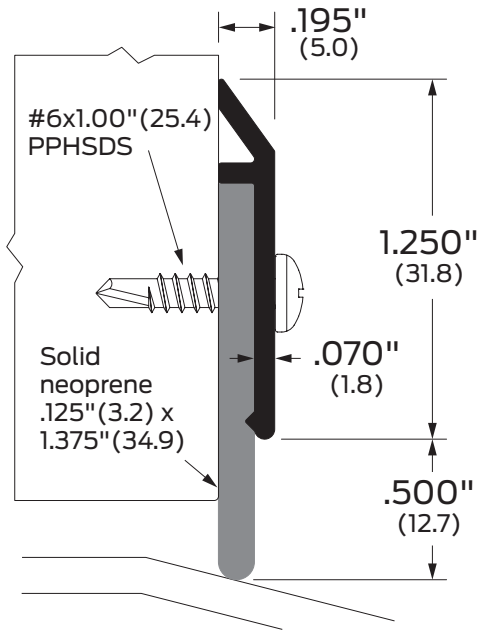
www.zerointernational.com

Part No:	Part description:
39	Door sweep

Notes:	Provided by:	
Customer name:	Job no:	Date:

Image may not be shown to scale



Certifications:

Fire rated-UL10c

ANSI/BHMA:

39A, 39BK, 39D, 39G R3B434

BHMA CERTIFIED

Finishes:

A	Aluminum mill finish
BK	Aluminum black anodized
D	Aluminum dark bronze anodized
G	Aluminum gold anodized

Options:

S	Order as a set
SEC	Security screws

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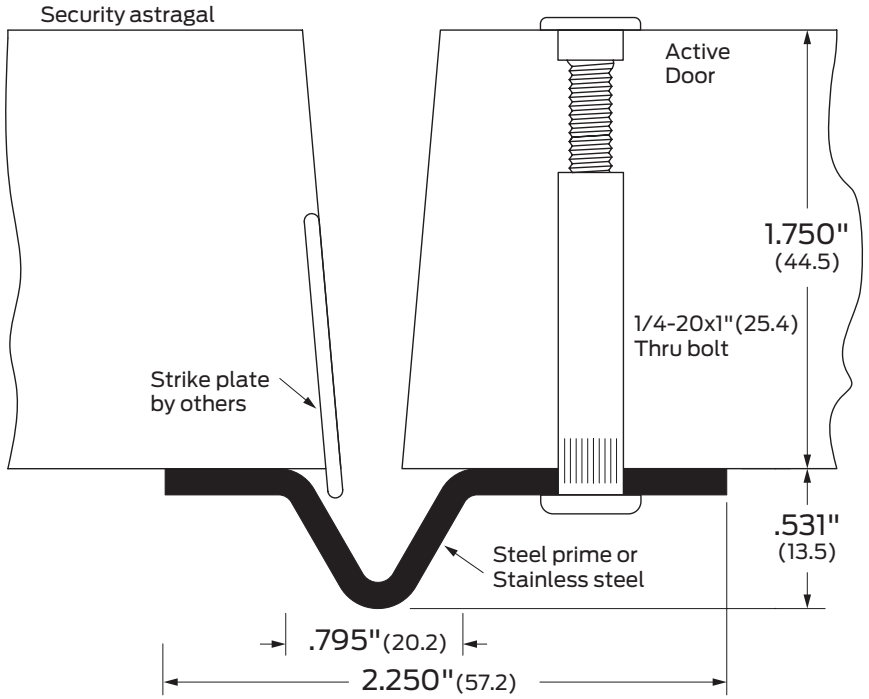
www.zerointernational.com

Part No:	Part description:
43	Meeting stile

Notes:	Provided by:	
Customer name:	Job no:	Date:

Image may not be shown to scale



Certifications:

Fire rated-UL10c

Finishes:

SP Steel primed
STST Stainless steel

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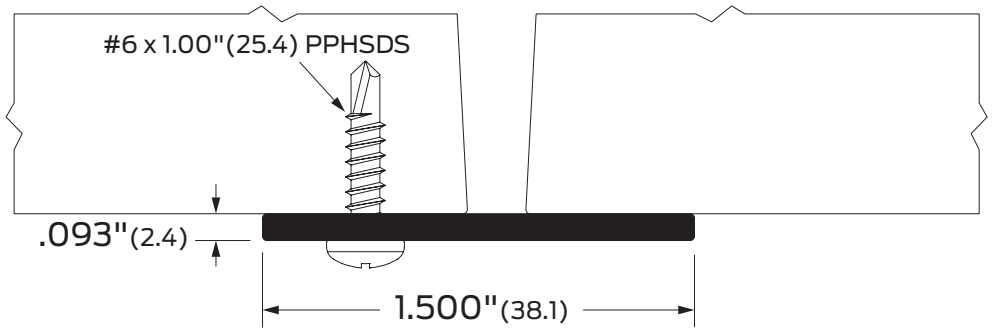
www.zerointernational.com

Part No:	Part description:
44	Meeting stile

Notes:	Provided by:	
Customer name:	Job no:	Date:

Image may not be shown to scale



Notes:
Stainless steel finish only.

ANSI/BHMA:

44STST R5Y636

Finishes:

STST Stainless steel

Options:

SEC Security screws

BHMA CERTIFIED

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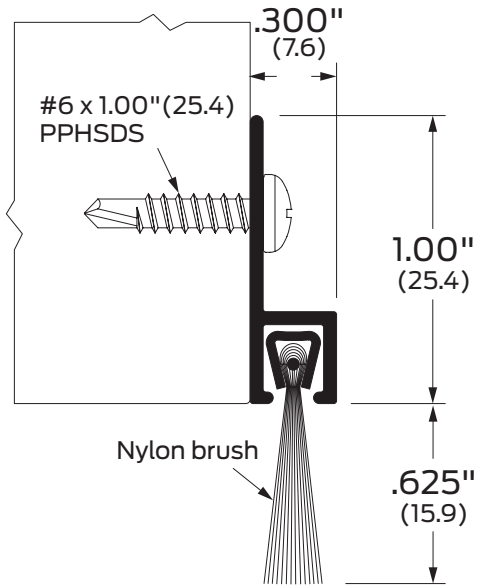
Zero.Customer.Support@allegion.com
www.zerointernational.com

Part No:	Part description:
8192	Door sweep, meeting stile

Notes:	Provided by:	
Customer name:	Job no:	Date:

Image may not be shown to scale



Certifications:

Fire rated-UL10c

ANSI/BHMA:

8192AA, 8192BK, 8192D, 8192G R3A436, R3A735

BHMA CERTIFIED

Finishes:

AA	Aluminum clear anodized
BK	Aluminum black anodized
D	Aluminum dark bronze anodized
G	Aluminum gold anodized

Options:

PSA	Pressure-sensitive adhesive
SEC	Security screws

LEED SILVER SCORECARD

LEED v4.1 BD+C
Project Checklist

Project Name: Berkeley Community College - Silver
Date: 05.03.2022

Y	?	??	N			
1				Credit	Integrative Process	1

13	1	0	2	Location and Transportation	16
				Credit	LEED for Neighborhood Development Location	16
1				Credit	Sensitive Land Protection	1
1	1			Credit	High Priority Site and Equitable Development	2
5				Credit	Surrounding Density and Diverse Uses	5
5				Credit	Access to Quality Transit	5
			1	Credit	Bicycle Facilities	1
1				Credit	Reduced Parking Footprint	1
			1	Credit	Electric Vehicles	1

4	0	0	6	Sustainable Sites	10
Y				Prereq	Construction Activity Pollution Prevention	Required
1				Credit	Site Assessment	1
			2	Credit	Protect or Restore Habitat	2
			1	Credit	Open Space	1
			3	Credit	Rainwater Management	3
2				Credit	Heat Island Reduction	2
1				Credit	Light Pollution Reduction	1

4	1	0	6	Water Efficiency	11
Y				Prereq	Outdoor Water Use Reduction	Required
Y				Prereq	Indoor Water Use Reduction	Required
Y				Prereq	Building-Level Water Metering	Required
1			1	Credit	Outdoor Water Use Reduction	2
2	1		3	Credit	Indoor Water Use Reduction	6
			2	Credit	Optimize Process Water Use	2
1				Credit	Water Metering	1

17	6	4	6	Energy and Atmosphere	33
Y				Prereq	Fundamental Commissioning and Verification	Required
Y				Prereq	Minimum Energy Performance	Required
Y				Prereq	Building-Level Energy Metering	Required
Y				Prereq	Fundamental Refrigerant Management	Required
3		1	2	Credit	Enhanced Commissioning	6
10	2	2	4	Credit	Optimize Energy Performance	18
	1			Credit	Advanced Energy Metering	1
		1	1	Credit	Grid Harmonization	2
3	2			Credit	Renewable Energy	5
1				Credit	Enhanced Refrigerant Management	1

1	3	3	6	Materials and Resources	13
Y				Prereq	Storage and Collection of Recyclables	Required
			5	Credit	Building Life-Cycle Impact Reduction	5
		1		Credit	Environmental Product Declarations	2
		1		Credit	Sourcing of Raw Materials	2
		1	1	Credit	Material Ingredients	2
	1	1		Credit	Construction and Demolition Waste Management	2
1	1			Credit		

9	2	2	3	Indoor Environmental Quality	16
Y				Prereq	Minimum Indoor Air Quality Performance	Required
Y				Prereq	Environmental Tobacco Smoke Control	Required
2				Credit	Enhanced Indoor Air Quality Strategies	2
2		1		Credit	Low-Emitting Materials	3
1				Credit	Construction Indoor Air Quality Management Plan	1
1		1		Credit	Indoor Air Quality Assessment	2
1			1	Credit	Thermal Comfort	1
			1	Credit	Interior Lighting	2
1	1		2	Credit	Daylight	3
1			0	Credit	Quality Views	1
1			0	Credit	Acoustic Performance	1

3	3	0	0	Innovation	6
	1			Credit	Pilot: EQpc44-Ergonomics	1
	1			Credit	Green Building Education	1
1				Credit	Pilot: Third Party Verified Recycling Facility	1
1				Credit	All Gender Restroom	1
1				Credit	EP Renewable Energy	1
	1			Credit	LEED Accredited Professional	1
1				Credit		

2	0	1	1	Regional Priority	4
1				Credit	RP: Access to Quality Transit (4)	1
			1	Credit	RP: Indoor Water Use Reduction (4)	1
				Credit	RP: BPDO-Sourcing	1
1		1		Credit	RP: Optimize Energy Performance (10)	1

54	16	10	30	TOTALS	Possible Points: 110

Certified: 40 to 49 points; Silver: 50 to 59 points; Gold: 60 to 79 points; Platinum: 80 to 110