

PROJECT MANUAL



HORRY COUNTY SCHOOLS WATERWAY ELEMENTARY SCHOOL ROOFING REPLACEMENT

700 SANDRIDGE ROAD
LITTLE RIVER, SC 29566

BID DOCUMENTS

APRIL 22, 2022

ARCHITECT



701-A LADY STREET
COLUMBIA, SC 29201
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LS3P COMMISSION NO.: 2201-218720

2022

VOLUME No. 1 OF 1
Divisions 00 through 26

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DOCUMENT 001113 - SOLICITATION FOR BIDS

PART 1 - GENERAL

1.1 PUBLIC NOTICES AND SOLICITATIONS FROM HORRY COUNTY SCHOOLS

- A. All notices, the award, this solicitation, and any addenda shall be posted at the following web address location:

1. <https://vrapp.vendorregistry.com/Bids/View/BidsList?BuyerId=2f302e8a-69b0-407b-a21a-3368d004365e>

END OF DOCUMENT 001113

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DOCUMENT 002600 - PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 012500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
 - 3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing by prime contract Bidder only in compliance with the following requirements:
 - 1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.

-
2. Submittal Format: Submit Procurement Substitution Request, using format provided in Project Manual, and submit to the District bid contact person as indicated on the invitation to bid.
 - a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
 - b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
 - 1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
 - 2) Copies of current, independent third-party test data of salient product or system characteristics.
 - 3) Samples where applicable or when requested by Architect.
 - 4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - 5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - 6) Research reports, where applicable, evidencing compliance with building code in effect for Project, from ICC-ES.
 - 7) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate the proposed substitute.
 - c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
 - d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.
 - B. Architect's Action:
 1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will authorize the District to notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.
 - C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

END OF DOCUMENT 002600

DOCUMENT 002600A - PROCUREMENT SUBSTITUTION REQUEST FORM

COMPLETE AND SUBMIT THIS FORM FOR APPROVAL OF SUBSTITUTES
(VIA ELECTRONIC SUBMISSION)

TO: Allen R. Taylor, AIA; allentaylor@ls3p.com, __

PROJECT NAME: Waterway Elementary School Roofing Replacement, 2201-218720

SPECIFIED ITEM PROPOSED TO BE REPLACED:

| Section | Paragraph | Specified Item |
|---------|-----------|----------------|
| _____ | _____ | _____ |

PROPOSED SUBSTITUTION: _____

- 1) Attach complete technical data, including laboratory tests, if applicable.
- 2) Include complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.
- 3) Provide the following information detailing the effect the substitution will have on the project.:
 - A. Does the substitution affect dimensions shown on the drawings?
Yes ____ No ____
 - B. Will the undersigned pay for changes to building design, including engineering and detailing costs caused by the requested substitution?
Yes ____ No ____
 - C. What effect does proposed substitution have on other trades?

 - D. What differences are there between specified item and proposed substitution?

 - E. Manufacturer's guarantees of proposed and specified items are:
Same ____ Different ____ (explain below and on attachments)

The Undersigned states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

Submitted by:

Print Name

Signature

Title

Date

Firm

Address

City/State/Zip

Telephone

Fax

For Use by Design Consultant

___Accepted

___ Accepted as Noted

___Not Accepted

___Received Too Late

Signature

Printed Name

Date

NOTES:

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project Information
2. Contract description.
3. Work by Owner or other Work at the Site.
4. Owner-furnished products.
5. Contractor's use of Site and premises.
6. Future work.
7. Work sequence.
8. Owner occupancy.
9. Permits.
10. Specification conventions.

1.2 PROJECT INFORMATION

A. Project Identification: Waterway Elementary School Roofing Replacement; 2201-218720.

1. Project Location: 700 Sandridge Road, Little River, SC 29566.

B. Owner: Horry County Schools, 335 Four Mile Road, Conway, SC 29526.

1. Owner's Representative: Frank Smith, AIA, Project Manager;
fsmith001@horrycountyschools.net.

C. Architect: LS3P ASSOCIATES LTD., 701-A Lady Street, Columbia, SC 29201; Phone: (803) 765-2418, Fax: (803) 765-2419.

1. Architect's Representative: Allen R. Taylor, AIA, LEED AP BD+C, GGP, Vice
President/Principal; allentaylor@ls3p.com.

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Roofing Consultant: WM Building Envelope Consultants, LLC, 1501 Chapin Road,
Chapin, SC 29036; (803) 260-4532.
 - a. Representative: Chris Waites; chris@wmbeconsultants.com

2. Mechanical and Electrical Engineering Consultant: Buford Goff & Associates, Inc., 1331 Elmwood Avenue, Suite 200, Columbia, SC 29201; Phone: (803) 254-5302, Fax: (803) 771-6142.
 - a. Mechanical Engineer Representative: Dan Reider, P.E.; dan.reider@bgainc.com.
 - b. Electrical Engineer Representative: Brian Melson, P.E.; brian.melson@bgainc.com

1.3 CONTRACT DESCRIPTION

- A. Work of the Project includes construction or alteration per the project drawings and specifications.
- B. Contract with Owner according to Conditions of Contract.

1.4 WORK BY OWNER OR OTHERS

- A. If Owner-awarded contracts interfere with each other due to work being performed at the same time or at the same Site, Owner will determine the sequence of work under all contracts according to "Work Sequence" and "Contractor's Use of Site and Premises" Articles in this Section.
- B. Coordinate Work with utilities of Owner and public or private agencies.
- C. Work under this Contract includes:
 1. It is a roof replacement of Waterway Elementary that may also involve some mechanical and electrical work as well depending on the site investigation.
 2. Work as indicated on Drawings.
- D. Items noted NIC (Not in Contract) will be furnished and installed by Owner.

1.5 OWNER-FURNISHED PRODUCTS

- A. Owner's Responsibilities:
 1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples to Contractor.
 2. Arrange and pay for delivery to Site.
 3. Upon delivery, inspect products jointly with Contractor.
 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
 1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.

2. Receive and unload products at Site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install, and finish products.
4. Repair or replace items damaged after receipt.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limit use of Site and premises to allow:

1. Owner occupancy.
2. Work by Owner.

B. Construction Operations: Limited to areas indicated on Drawings.

1. Noisy and Disruptive Operations (such as Use of Jack Hammers and Other Noisy Equipment): Not allowed in close proximity to existing building during regular hours of operation. Coordinate and schedule such operations with Owner to minimize disruptions.

C. Utility Outages and Shutdown:

1. Coordinate and schedule electrical and other utility outages with Owner.
2. Outages: Allowed only at previously agreed upon times. In general, schedule outages at times when facility is not being used.

D. Construction Plan: Before start of construction, submit three copies of construction plan regarding access to Work, use of Site, and utility outages for acceptance by Owner. After acceptance of plan, construction operations shall comply with accepted plan unless deviations are accepted by Owner in writing.

1.7 PERMITS

- A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

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SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for allowances.
- B. The allowance is to be included in the base bid.
- C. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

- A. Allowance is an amount specified and included in the construction documents for a certain item of work whose details are not yet determined.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALLOWANCES

- A. General Lump Sum: \$80,000.00

END OF SECTION 012100

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SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes unit price quantities, and administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

- A. Unit price is a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.
- B. The base bid is to include unit price quantities included in the documents.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

- D. The Contractor is required to notify the Consultant, in writing, when approximately 75% of unit price quantities have been used.
- E. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. 2x6 Rough Carpentry:
- 1. LF
- B. Metal Roof Deck Repairs
- 1. SF
- C. Metal Roof Deck Replacement:
- 1. SF
- D. Roof Deck Fastener Installation:
- 1. EA
- E. 2" Polyisocyanurate Roof Insulation Replacement:
- 1. SF
- F. ¼:12 Tapered Polyisocyanurate Roof Insulation Replacement:
- 1. SF
- G. ¾" Perlite Roof Insulation Replacement:
- 1. SF
- H. 3" Polyisocyanurate Roof Insulation Replacement:
- 1. SF
- I. Roof Drain Replacement
- 1. EA

END OF SECTION

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount that may be added to or deducted from the Contract Sum 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. 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.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. 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.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Roof Replacement.

1. Base Bid: Demolition and removal of existing low slope roof systems down to the existing roof insulation on Roof Areas A, B, C, C1, D, E, E1, E2, F, and F1 for replacement with a new cover board and mechanically attached TPO roof membrane system. Removal and replacement of wet insulation materials is also required as necessary for the installation of a new recovery low slope roof system.
2. Alternate No. 1: Demolition and removal of the existing low slope roof system where wet insulation materials exist on Roof Areas I and J as necessary for the installation of a new recovery low slope roof system. Areas of existing roof assembly removed shall be filled with like material of equal thickness.
3. Alternate No. 2: Demolition and removal of existing low slope roof systems down to the existing roof insulation on Roof Areas G and H for replacement with a new cover board and mechanically attached TPO roof membrane system.
4. Alternate No. 3: Demolition and removal of all scupper liners, sheet metal copings, and sheet metal flashings for replacement with new.
5. Alternate No. 4: Replace existing rooftop HVAC units at roof area I as indicated on mechanical drawings.

3.2 END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. Section 012100 "Allowances" for products selected under an allowance.
 - 3. Section 012300 "Alternates" for products selected under an alternate.
 - 4. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience (Not Allowed): Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

-
- a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance:
 - 1) During Bid Phase: Addenda.
 - 2) During Construction: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

- 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, Insert number of days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use form acceptable to Architect.

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 EXTENSION OF TIME DUE TO WEATHER

A. General: This article establishes conditions and procedures for amending the Contract Time when excess adverse weather conditions have repeatedly caused cancellation of schedule critical activities, resulting in delay to the Project.

B. Definitions:

1. Adverse Weather: Job site environmental conditions in which precipitation, or soil conditions resulting from precipitation, or ambient temperature conditions during working hours preclude carrying out a Scheduled Critical Activity. The following conditions may be considered by the Architect in determining the extent of excess adverse weather conditions, depending upon the nature of the delayed project tasks:
 - a. Precipitation greater than 0.1 inch of water equivalent per day.
 - b. Days on which the average air temperature does not exceed 40 degrees F.
 - c. Other weather conditions deemed hazardous by the Contractor.
2. Scheduled Critical Activity: Project tasks, the delay of which will directly result in a delay in the completion of the project.
3. Excess Adverse Weather: Adverse weather occurring in excess of the normal, cumulative number of calendar days of adverse weather as listed below:

| Month | Normal | Month | Normal |
|----------|--------|--------------|--------|
| January | 6 | July | 7 |
| February | 5 | August | 8 |
| March | 5 | September | 6 |
| April | 5 | October | 4 |
| May | 4 | November | 4 |
| June | 6 | December | 5 |
| | | Total Annual | 65 |

4.

C. Claim for Extension of Time Due to Weather:

1. Contractor shall file claim for each month during which adverse weather occurs.
 - a. Attach copies of Contractor’s Daily Reports for each day of adverse weather, describing fully the weather conditions, schedule activities delayed, and reasons for the delay.
 - b. Include photographs where applicable for documenting soil conditions.
 - c. Attach copy of NCDC/NOAA Local Climatological Data report for given month, or other published U.S. or state monthly weather data acceptable to Architect.

2. Claim shall be filed for a calendar month by attaching the completed form to the Application for Payment submitted the following month.
3. Architect shall review and approve or take other action upon Contractor's Claim for Extension of Time. Adjustment of Contract Time shall be made by a single Change Order prepared at project closeout.0

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
 - 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 011000 "Summary."

- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
 2. Arrange schedule of values consistent with format of AIA Document G703.
 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
 8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.

9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
11. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
12. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.

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2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Sustainable design action plans, including preliminary project materials cost data.
 7. Schedule of unit prices.
 8. Submittal schedule (preliminary if not final).
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.

12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Initial progress report.
 14. Report of preconstruction conference.
 15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.
- I. Subsequent Application for Payment: After issuing the Initial Application for Payment, administrative actions and submittals that must precede or coincide with submittal of remaining Applications for Payment include the following:
1. Reports and other documents indicated in Division 01 Section "Construction Progress Documentation."
 2. Closeout Submittal List (preliminary, if not final).
- J. Retainage Reduction:
1. Owner shall pay the amount due to the Contractor on account of progress payments as indicated in the Agreement. After completion of a percentage of the Work, as agreed, the Contractor shall submit, for Owner's and Architect's review and approval a written request for retainage reduction. Upon Owner's approval, with written consent of the surety, the Architect may certify remaining partial payments to be paid in full.
 2. The Contractor, as a condition precedent to retainage reduction shall submit, for review and approval by the Architect, the required O&M manual.
- K. Application for Payment at Substantial Completion : After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- L. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.

7. AIA Document G707.
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 CONTRACT DOCUMENT

- A. The Contract Agreement with referenced attachments, technical specifications and drawings including all project addenda constitute the Scope of the Work.
- B. Specific project requirements are included in the Contract Agreement and contain, but may include more than the following:
 - 1. Pre-Construction Meeting
 - 2. Construction Management
 - 3. Conformance to applicable Codes and Laws
 - 4. Project Schedule
 - 5. SLED Background checks
 - 6. Submittals
 - 7. Record Drawings
 - 8. Quality Control
 - 9. Cut and Patching
 - 10. Jobsite Supervision
 - 11. Work site control and clean-up.
 - 12. Material testing and Inspections
 - 13. Warranties and Guarantees
 - 14. Traffic Control and Safety
- C. Important safety and specific Horry County School requirements are contained in the Contract Agreement and specifically Section 83 “Mandatory Safety and Conduct Requirements.”

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Those work restrictions and limitations listed on the Scope of Work (Exhibit A) and the Contract Agreement.

1.3 UTILITY USE AND CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless specifically noted otherwise within the Scope of Work (Exhibit A) to the Contract Agreement. Allow other entities to use temporary services and facilities without

cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Requirement for temporary utilities if paid for by the Contractor:

1. Sewer Service: **Pay** sewer-service use charges for sewer usage by all entities for construction operations.
2. Water Service: **Pay** water-service use charges for water used by all entities for construction operations.
3. Electric Power Service: **Pay** electric-power-service use charges for electricity used by all entities for construction operations.

C. Requirement for temporary utilities if paid for by the Owner:

1. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations at no cost to the Owner.
2. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations at no cost to the Owner.
 - 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. Obtain required certifications and permits.

1.4 QUALITY ASSURANCE

- 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. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

1.6 DEFINITIONS

- A. Included within the **Contract agreement** and within each specific specification section.

PART 2 - PRODUCTS

2.1 TEMPORARY FENCING

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch-OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in **Contract agreement**. Keep office clean and orderly.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. 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 progress of the Work.
 - 1. Locate facilities to limit site disturbance.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- D. Heating: Provide temporary heating 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 that will not have a harmful effect on completed installations or elements being installed.
- E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. Install lighting for Project identification sign.

- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel
1. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touchup signs so they are legible at all times.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

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- C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- F. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations and / or as indicated on Drawings.
 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- J. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.
1. Construct covered walkways using scaffold or shoring framing.
 2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 3. Paint and maintain appearance of walkway for duration of the Work.
- K. 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.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

- L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
 3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 4. Insulate partitions to control noise transmission to occupied areas.
 5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 6. Protect air-handling equipment.
 7. Provide walk-off mats at each entrance through temporary partition.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
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.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. 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.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. 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.

3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3.
 - 4. Daily construction reports.
 - 5. Site condition reports.
 - 6. Unusual event reports.
- B. Related Requirements:
 - 1. Section 014000 "Quality Requirements" for schedule of tests and inspections.
 - 2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.3 DEFINITIONS

- A. General: Refer to the glossary of terms in AGC's "Construction Planning & Scheduling" for terminology used in this section.
- B. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- C. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
1. Working electronic copy of schedule file.
 2. PDF file.
- B. Startup construction schedule.
1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial and updated) and date.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 3. Total Float Report: List of activities sorted in ascending order of total float.
 4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at weekly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Unusual Event Reports: Submit at time of unusual event.
- J. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contracts.
- B. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for the Notice of Award to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than **30** days, unless specifically allowed by Architect.
 - 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 5. Startup and Testing Time: Include no fewer than **14** days for startup and testing.
 6. Commissioning Time: Include no fewer than 15 days for commissioning.
 7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 8. Punch List and Final Completion: Include not more than the days indicated in the Agreement for completion of punch list items and Final Completion.
 - 9.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Use-of-premises restrictions.
 - e. Provisions for future construction.
 - f. Seasonal variations.
 - g. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.

- i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion
- F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.
- H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Final Completion percentage for each activity.
- I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working

hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

- J. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
- K. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1.8 STARTUP CONSTRUCTION SCHEDULE

- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
 - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.10 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

-
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice of Award.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and Final Completion.
 - l. Activities occurring following Final Completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.

- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).

- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.

4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.11 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. Construction Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Substantial Completions authorized.
- B. Material Location Reports: At regular intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or

effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 HYPERLINK

"[HTTP://CONTACT.ARCOMNET.COM/CONTENTCONTACT.ASPX?SECT=013233&VER=09/01/15&FORMAT=FL&SID=11463](http://CONTACT.ARCOMNET.COM/CONTENTCONTACT.ASPX?SECT=013233&VER=09/01/15&FORMAT=FL&SID=11463)" RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for photographs taken to document progress of construction.
- B. Related Requirements:
1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
1. Submit photos by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
 2. Identification: Provide the following information with each image description in web-based project software site:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time from camera.
- D. File Names: Name media files with date and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Designate employee with sufficient experience and skill to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of excavation, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
- D. Periodic Construction Photographs: Take 20 photographs weekly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take 100 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.2 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of digital data files of the Contract Drawings are not available from the Architect for Contractor's use in preparing submittals.
 - 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
- B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow **15 days** for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow **15 days** for review of each resubmittal.
- C. Paper Submittals: Unless otherwise indicated, paper submittals are not acceptable.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use software-generated form from Project Information Management System.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations: Identify deviations from the Contract Documents on submittals.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
 1. Post electronic submittals as PDF electronic files directly to Project Information Management System specifically established for Project.
 - a. Architect will annotate file and return when review is complete.

2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. Submit Product Data before or concurrent with Samples.
 2. Submit Product Data in the following format:
 - a. PDF electronic file.

- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
 1. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 2. Submit Shop Drawings in the following format:
 - a. PDF electronic file.

- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 3. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected.
 - a. Number of Samples: Submit **three** sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
 - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least **three** sets of paired units that show approximate limits of variations.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and **three** paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, annotate to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
1. No Exceptions Taken: The work covered by the submittal may proceed.
 2. Note Markings: The work covered by the submittal may proceed provided it complies with both the Architect's notations and corrections on the submittal and the Contract Documents.
 3. Rejected: Do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the contract document.

- C. Informational Submittals: Architect will review each submittal and will return it, noting “No Action Taken.” If it does not comply with requirements, Architect will return it noting “Revise and Resubmit.” Architect will forward each submittal to appropriate party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review, with notation “Revise and Resubmit”.
- F. Submittals not required by the Contract Documents may be returned by the Architect without action, with notation “No Action Taken”.

END OF SECTION 013300

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- D. 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 authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of **five** previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

- J. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- K. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- L. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- M. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- N. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- O. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- P. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

1.3 CONFLICTING REQUIREMENTS

- A. Referenced Standards: 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 conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

- B. 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 Architect for a decision before proceeding.

1.4 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections.
- B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections.
- C. Permits, Licenses, and Certificates: For Owner'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 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing 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.
- B. 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.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- D. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- E. Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of

manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.6 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
- C. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Associated Services: 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.
- F. Coordination: Coordinate sequence of 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.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.7 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections attached to this Section, and as follows:
- B. Special Tests and Inspections: Conducted by a qualified special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections and in Statement of Special Inspections attached to this Section, and as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Architect, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.

4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Construction Manager's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

END OF SECTION 014000

Attachments:
Schedule of Special Inspections

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.2 QUALITY ASSURANCE

- 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. Obtain required certifications and permits.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.
- C. Contractor shall have use of an area of existing building for use as field office, as designated by Owner. Restore area to pre-occupancy condition or renovate as required by Contract Documents prior to Substantial Completion.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures".

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to private system indicated as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities have jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

- F. 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 that will not have a harmful effect on completed installations or elements being installed
- G. 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 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.
- H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
1. Connect temporary service to Owner's existing power source, as directed by Owner.
- J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 2. Provide superintendent with cellular telephone for use when away from field office.
- L. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access project electronic documents and maintain electronic communications. Provide continuing security for system.

3.2 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as shown on the attached Drawing. Architect will provide file for sign copy and rendering for use by printer.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touchup signs so they are legible at all times.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- D. 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.
 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- E. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.

3.4 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain facilities in good operating condition until removal.

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.
- B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. 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.
 1. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period.

END OF SECTION 015000

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 012500 DEFINITIONS

- A. Products: Items obtained 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.
- B. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- C. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.2 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1.4 PRODUCT WARRANTIES

- A. 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 Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. Refer to other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

- A. 012500Confirmation of Finish Selections: Final selection of finish materials, colors, patterns, and textures will be based on Owner's approval of samples. Confirm selection before ordering materials or beginning installation.
- B. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- C. 012500Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

- B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.

- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Certified Surveys: Submit two copies signed by land surveyor.
- F. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.

- d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Fire-detection and -alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Existing Conditions: 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 location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, 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.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner 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 authorities having jurisdiction.
- B. 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.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 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.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- C. 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.
- D. 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 Architect.

3.4 FIELD ENGINEERING

- A. Reference 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.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points

- promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. 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.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. 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.
- D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.

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- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

- a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.

-
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - D. 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.
 - E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
 - F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
 - G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
 - H. 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.
 - I. 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.
 - J. 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.

3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From all authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 5 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 3. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 5 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 2. Complete final cleaning requirements, including touchup painting.
 3. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect, Engineer and Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect and Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by the Architect and Engineer, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected. Contractor shall compensate Architect and Engineer at the firm's standard billing rates for additional reinspections beyond the first.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: .
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected. Contractor shall compensate Architect and Engineer at the firm's standard billing rates for additional reinspections beyond the first. .

1.6 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Owner for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: 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.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
- C. Construction Waste Disposal: Comply with waste disposal requirements specified.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

1.3 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will determine whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will determine whether general scope and content of manual are acceptable.

- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within **15** days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:

1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, **loose-leaf** binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

- b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.

9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available. Provide recording in commonly used digital format.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and

flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
1. Record Drawings.
 2. Record Specifications.
 3. Record Product Data.
 4. Miscellaneous record submittals.

1.2 CLOSEOUT SUBMITTALS

1. Record Drawings: Comply with the following. Number of Copies: Submit one set(s) of marked-up record prints.
 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one set of prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal.
1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. Mark important additional information that was either shown schematically or omitted from original Drawings.
 5. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's and Owner's reference at all times work is being performed.

END OF SECTION 017839

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.

- d. Name of Contractor.
 - e. Date of video recording.
2. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Operations manuals.
 - b. Maintenance manuals.
 - c. Project record documents.

- d. Identification systems.
 - e. Warranties and bonds.
 - f. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.

8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 3. Owner will furnish Contractor with names and positions of participants.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 1. At beginning of each training module, record each chart containing learning objective and lesson outline.

- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 2. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 3. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
1. Furnish additional portable lighting as required.
- E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

B. Related Requirements

1. Section 012300 "Alternates" for Alternate No. 6B regarding skylight demolition.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of all items off-site unless indicated to be removed and salvaged or removed and reinstalled.

1. Removal of items includes debris from skylight demolition if Alternate No. 6B is accepted.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
4. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Owner of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain all existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
 - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Comply with requirements for access and protection specified in Section 013100 "Project management and Coordination."
 - 2.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area off-site designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weatherproof. See Appropriate Specification Section for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an-approved landfill.
 - 1. Do not allow demolished materials to 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 demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including the General and Supplemental Conditions, as well as other Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Base Bid: Demolition and removal of existing low slope roof membrane systems down to the existing roof insulation on Roof Areas A, B, C, C1, D, E, E1, E2, F, and F1 for replacement with a new cover board and mechanically attached TPO roof membrane system. Removal and replacement of wet insulation materials is also required as necessary for the installation of a new recovery low slope roof system.
2. Alternate No. 1: Demolition and removal of the existing low slope roof system where wet insulation materials exist on Roof Areas I and J as necessary for the installation of a new recovery low slope roof system. Areas of existing roof assembly removed shall be filled with like material of equal thickness.
3. Alternate No. 2: Demolition and removal of existing low slope roof membrane systems down to the existing roof insulation on Roof Areas G and H for replacement with a new cover board and mechanically attached TPO roof membrane system.
4. Alternate No. 3: Demolition and removal of all scupper liners, sheet metal copings, and sheet metal flashings for replacement with new.
5. Removal of abandoned skylights and equipment is required with roof deck properly repaired.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- C. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 INFORMATIONAL SUBMITTALS

- A. Predemolition Photographs or Video: Submit before Work begins.

1.5 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Consultant of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. If any suspected hazardous materials are encountered, do not disturb; immediately notify Consultant and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Consultant.
- D. Engage a professional engineer (if any structural element will be modified, removed, and/or addressed) to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 - 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing roof system only to the extent required by new roof system and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut roof system in straight lines taking in account tie in locations in relation to existing water flow. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain. Do not cut roof system creating a back lap for sheeting water to drain.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Remove all existing fasteners utilizing mechanical drills.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations.
5. Maintain fire watch and portable fire-suppression devices during flame-cutting operations and/or torching or roof system. Fire watch shall be a minimum of 2 hours.
6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
7. Remove all demolished items from roof in a manner to not damage exterior of facility and select locations determined by Owner.

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Consultant, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

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PART 1 - SECTION 052100 - STEEL JOISTS

PART 2 - GENERAL

2.1 SUMMARY

- A. This Section includes the following:
 - 1. Open-web, K-series steel joists.
 - 2. KCS-type, open-web, K-series steel joists, if applicable.
 - 3. Joist girders, if applicable.

2.2 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. Shop Drawings: Showing layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
- C. Welding certificates.

2.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
 - 1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.
- B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

2.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

PART 3 - PRODUCTS**3.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional, structural engineer, as defined in Section 014000 – Quality Requirements, to design steel joists and joist girders for Project.
 - 1. Structural Engineer shall be currently licensed in the State of South Carolina.

3.2 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.
- B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers; plain, uncoated.
- C. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers; plain, uncoated.

3.3 PRIMERS

- A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.

3.4 STEEL JOISTS

- A. Manufacture steel joists according to SJI's "Specifications," with steel-angle top- and bottom-chord members, and as follows:
 - 1. Manufacture K-series and KCS-type, K-series steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

3.5 JOIST GIRDERS

- A. Manufacture joist girders according to "Standard Specifications for Joist Girders," in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements indicated.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

3.6 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications."
- C. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

3.7 SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Apply 1 shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
- C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts, unless otherwise indicated.
- E. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

END OF SECTION 052100

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SECTION 053100 - STEEL DECKING

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. Roof Deck Repairs where existing roof deck locations are rusted and require sanding, priming, and painting. A unit price is required to be provided to adjust the contract sum based on the actual amount used.
2. Roof Deck Replacement where existing roof deck locations are deteriorated beyond repair and needs replacement. A unit price is required to be provided to adjust the contract sum based on the actual amount used.

B. Related Requirements:

1. Section 012200 "Unit Prices".

1.3 REFERENCES

A. Steel Deck Institute (SDI)

1. Manual of Construction with Steel Deck – No. MOC3
2. SDI Roof Deck Design Manual – No. RDDM

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
- B. Evaluation Reports: For steel deck.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

- A. Roof Deck: Provide deck panels to match existing in type and profile, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), minimum 22 gage with zinc coating.
 - 2. Side Laps: Overlapped and screw fastened.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.
- E. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. ROOF DECK FASTENER INSTALLATION: Examine roof deck for attachment patterns in the field and perimeter conditions. Fasteners shall be provided attaching roof deck to structural steel a minimum of 6" O.C. in the field and 6" O.C. in the perimeter condition. Fasteners shall be provided in the deck laps 6" O.C. in deck laps.
 - 1. Side laps shall be attached 6" O.C. in field, 3" O.C. in perimeters, and 3" O.C. in corners.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

- B. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- C. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- D. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- E. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- F. Mechanical fasteners shall be used to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK REPLACEMENT

- A. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 18 inches.
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- B. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- C. Roof deck replacement locations shall extend over a minimum of 2 bar joists in area of replacement.
- D. Roof Deck attachment to substrate: Fasten roof deck to substrate with fasteners minimum of 6" O.C. in the field and 6" O.C. in the perimeter.

3.4 FIELD QUALITY CONTROL

- A. Remove and replace work that does not comply with specified requirements.

3.5 ROOF DECK REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- A. Repair Painting: Wire brush and clean rust spots, apply zinc rich primer to prepared areas.
 - 1. Prepare the roof deck in accordance with the zinc rich primer manufacturer's printed instructions. A minimum of a mechanical sanding/brushing is required.

END OF SECTION

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SECTION 054000 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof rafter framing.
2. Ceiling joist framing.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 – Project Management and Coordination.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

- C. Delegated-Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

B. Welding certificates.

- C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips

7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products to match existing, or comparable product from one of the following:

1. Allsteel & Gypsum Products, Inc.
2. CEMCO; California Expanded Metals Co.
3. ClarkDietrich Building Systems, LLC.
4. Custom Stud Inc.
5. Genesis Worldwide Inc.
6. Marino\WARE.
7. MBA Building Supplies.
8. MRI Steel Framing, LLC.
9. Phillips Manufacturing Co.
10. SCAFCO Corporation.
11. Steel Construction Systems, LLC.
12. Steel Network, Inc. (The).
13. Telling Industries.
14. TrusSteel, an ITW Company.
15. United Metal Products, Inc.
16. Steel Structural Systems.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional, structural engineer, as defined in Section 014000 – Quality Requirements, to design cold-formed steel framing.
1. Structural Engineer shall be currently licensed in the State of South Carolina.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Roof Rafter Framing: Vertical deflection of 1/360 of horizontally projected span for live loads.
 - b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of span.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of [1/2 inch] [3/4 inch] [1 inch] [1-1/2 inches].
- C. Cold-Formed Steel Framing Design Standards:
1. Roof Systems: AISI S210.
 2. Headers: AISI S212.
 3. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST33H or as required by structural performance [ST50H].
2. Coating: G60, G90 or equivalent.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50, Class 1 or as required by structural performance [33].
2. Coating: G90 [G60].

2.4 ROOF-RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, as designed by licensed Structural Engineer, through Delegated Design. Design shall include Minimum Base-Metal Thickness and Flange Width

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, as designed by licensed Structural Engineer, through Delegated Design. Design shall include Minimum Base-Metal Thickness and Flange Width.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

1. Bracing, bridging, and solid blocking.
2. Web stiffeners.
3. Anchor clips.
4. End clips.
5. Foundation clips.
6. Gusset plates.
7. Stud kickers and knee braces.
8. Joist hangers and end closures.
9. Hole reinforcing plates.
10. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

- B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process per ASTM A153, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.
- B. Cement Grout: Portland cement, A STM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 075423 "Thermoplastic Polyolefin (TPO) Roofing," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing Work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 1. Anchor Spacing: As indicated on approved Shop Drawings 24 inches.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 1. Stud Spacing: As indicated on approved Shop Drawings 16 inches.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically 48 inches unless indicated otherwise, or as indicated on approved Shop Drawings. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
1. Joist Spacing: As indicated 16 inches.
- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.6 FIELD QUALITY CONTROL

- A. Testing: Owner will engage qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace Work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional Work with specified requirements.

3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of the contract, including the General and Supplemental Conditions, as well as other Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. New wood blocking/nailers are required at all perimeter locations and roof penetrations where shown on the details. Thickness of wood blocking/nailers are to match the thickness of the insulation system.
2. A unit price is required to be provided where existing wood blocking/nailers are found to be damaged/deteriorated and cannot be reused.

1.3 DEFINITIONS

- A. Lumber: Minimum 2 inches x 6 inches unless otherwise indicated.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 1. NLGA: National Lumber Grades Authority.
 2. SPIB: The Southern Pine Inspection Bureau.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 1. Preservative-treated wood.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.

2.2 DIMENSION LUMBER FRAMING

- A. Wood Blocking/Nailers:
1. Construction or No. 2 southern pine; Southern Pine Inspection Bureau (SPIB).
 2. Pressure-treated, kiln dried, intended for ground contact.
 3. Maximum Moisture Content of Lumber: 19 percent moisture content or less.
 4. Maximum Moisture Content of Plywood: 18 percent moisture content or less.
 5. Minimum 2" x 6" unless approved otherwise.
- B. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking / Nailers

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Fasteners shall be compatible with the wood treatment used.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
 2. For wood blocking attachment to steel, use a minimum of #12 stainless steel self-drilling fastener to penetrate steel structure below the roof panels a minimum of 1" depth. Install fasteners at a maximum of 12" on center and 6" at corners. One fastener shall be at a maximum of 6" from board end.

3. Provide a self-adhering underlayment between treated wood blocking and any sheet metal products including the counterflashing, etc.
4. If other substrate/edge conditions exist, the Contractor shall provide attachment to resist 250 pounds per square linear foot in all directions and increased by 100% at corners.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit.
- B. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous waterproof membrane separator between wood and metal panels.
- C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. Attach wood nailers to roof edges to meet the requirements of FM Global Property Loss Prevention Data Sheet 1-49, 2.2.4, 2.2.5, 2.2.6 and/or 2.2.7.

END OF SECTION

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SECTION 070150.19 - PREPARATION FOR REROOFING

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:

Base Bid

- 1. Scope of work includes removal of the existing low slope roof membrane system down to the existing roof insulation on Roof Areas A, B, C, C1, D, E, E1, E2, F, and F1 for replacement with a new cover board and mechanically attached TPO roof membrane system. Removal and replacement of wet insulation materials is required as necessary for the installation of a new recovery low slope roof system. Associated sheet metal components and accessories are included.

Alternate No. 1

- 1. Scope of work includes preparation of existing low slope aggregate surfaced built-up roof systems on Roof Areas I and J as necessary for the installation of a new recovery low slope roof system. Removal and replacement of all wet insulation materials is required as necessary for the installation of a new cover board and mechanically attached TPO roof membrane system. Areas of existing roof assembly removed shall be filled with like material of equal thickness. Installation of new wall panels is also required where shown on the drawings. Associated sheet metal components and accessories are included.

Alternate No. 2

- 1. Scope of work includes removal of the existing low slope roof membrane system down to the existing roof insulation on Roof Areas G and H for replacement with a new cover board and mechanically attached TPO roof membrane system. Removal and replacement of wet insulation materials is required as necessary for the installation of a new recovery low slope roof system. Associated components and accessories are included.

Alternate No. 3

- 1. Scope of work includes replacement all scupper liners and face plates, sheet metal copings, and sheet metal flashings not indicated otherwise for replacement. Associated components and accessories are included.

B. Related Requirements:

1. Section 011000, Summary
2. Section 015000, Temporary Facilities and Controls
3. Section 012300, Alternates
4. Section 075423, Thermoplastic Polyolefin (TPO) Roofing

1.3 UNIT PRICES

- A. Work of this Section is affected by unit price work in accordance with Section 012200, Unit Prices.

1.4 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.
- B. Full Roof Tear-Off: Removal of existing roofing system and all components and accessories of existing roofing systems down to roof decks.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, sections, and details.
- C. Temporary Roofing Submittal: Product data and description of temporary roofing system. If temporary roof remains in place, include surface preparation requirements needed to receive permanent roof, and submit a letter from roofing manufacturer, stating acceptance of the temporary roof and that its inclusion does not adversely affect the roofing system's resistance to fire and wind.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
1. Include certificate that Installer is approved by warrantor of existing roofing system.
- B. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Approved by warrantor of existing roofing system to work on specified roof system.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Reroofing Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Consultant, roofing system manufacturer's representative, roofing Installer, including project manager, superintendent, and foreman, and installers whose work interfaces with or affects reroofing, roof accessories, and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing system tear-off and replacement, including, but not limited to, the following:
 - a. Reroofing preparation, including roofing system manufacturer's written instructions.
 - b. Temporary protection requirements for existing roofing system components that are to remain.
 - c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
 - d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
 - e. Existing roof deck conditions requiring notification of Consultant.
 - f. Existing roof deck removal procedures and Owner notifications.
 - g. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
 - h. Structural loading limitations of roof deck during reroofing.
 - i. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
 - j. HVAC shutdown, sealing of air intakes and installation of charcoal filters.
 - k. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
 - l. Governing regulations and requirements for insurance and certificates if applicable.
 - m. Existing conditions that may require notification of consultant before proceeding.

1.8 FIELD CONDITIONS

- A. Existing Roofing System: See core data on drawings for roof assembly components. This information is provided as general information only. Contractor is required to verify all existing dimensions and conditions.
- B. Owner will occupy portions of building immediately below reroofing area. Conduct reroofing so Owner's operations are not disrupted. Provide Owner with not less than 72 hours notice of activities that may affect Owner's operations.
 - 1. Coordinate work activities daily with Owner so Owner can place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
 - 2. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below affected area. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.
- C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- E. Limit construction loads on roof and uniformly distributed loads as not to overload structure.
- F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
 - 1. Remove only as much roofing in one day as can be made watertight in the same day.
- G. If any suspected hazardous materials are encountered, do not disturb; immediately notify Consultant and Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Shut off rooftop utilities and service piping before beginning any Work.
- B. Protect existing roofing system that is not to be reroofed.
 - 1. Limit traffic and material storage to areas of existing roofing that have been protected.

2. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.
- C. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.
- D. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- E. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
 1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF

- A. General: Notify Owner of the location and extent of roof tear-off proposed for each day at least 24 hours prior to roof tear-off. A weekly schedule is required to be provided and is to be updated as needed to provide an accurate schedule.
- B. Full Roof Tear-Off: Remove existing roofing and other roofing system components down to the deck.
 1. Remove fasteners from deck in a manner that does not damage the existing deck. Fasteners in roof deck shall be removed utilizing screw guns.

3.3 DECK PREPARATION

- A. Inspect deck after tear-off of roofing system.
- B. Verify that substrate is visibly dry, free of any moisture, dirt and debris or any other surface contaminant.
- C. Properly patch the roof deck where existing abandoned penetrations are removed.
- D. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Consultant. Do not proceed with installation until directed by Consultant.
- E. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Consultant. Do not proceed with installation until directed by Consultant.

- F. Repair/Replace decks as required. The Contract Sum will be adjusted based on the unit cost provided for the quantity included in the Contract Documents.

3.4 INFILL MATERIALS INSTALLATION

- A. Immediately after roof tear-off, inspection and repair of deck, and installation of a water cut off system, fill in areas to match existing roofing system construction.
 - 1. Installation of wood blocking and nailers is specified in Section 061053 Miscellaneous Rough Carpentry.

3.5 DISPOSAL

- A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
 - 1. Storage or sale of demolished items or materials on-site is not permitted.
- B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION

SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

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. Base Bid: Removal of the existing single ply roof membrane on Roof Areas A, B, C, C1, D, E, E1, E2, F, and F1 in its entirety down to the existing roof system insulation. All damaged roof insulation is to be replaced with new to match existing in type and thickness. Installation of a minimum one-inch cover board and a mechanically attached thermoplastic polyolefin (TPO) roofing system. Excessive wrinkling of the newly installed roof membrane will not be acceptable.
2. Alternate No. 1: Preparation of the existing aggregate surfaced built-up roof system on Roof Areas I and J per the manufacturer's requirements and installation of a minimum one-inch cover board and a mechanically attached thermoplastic polyolefin (TPO) recover roofing system. All wet/damaged roof insulation is to be replaced with new to match existing in type and thickness. Excessive wrinkling of the newly installed roof membrane will not be acceptable.
3. Alternate No. 2: Removal of the existing single ply roof membrane on Roof Areas G and H in its entirety down to the existing roof system insulation. All damaged roof insulation is to be replaced with new to match existing in type and thickness. Installation of a minimum one-inch cover board and a mechanically attached thermoplastic polyolefin (TPO) roofing system. Excessive wrinkling of the newly installed roof membrane will not be acceptable.
4. Alternate No. 3: Scope of work includes replacement all scupper liners, sheet metal copings, and sheet metal flashings not indicated otherwise for replacement. Associated components and accessories are included.
5. Roof insulation.
 - a. Replacement of wet/moisture damaged roof insulation in areas shown on the drawings is required to be provided in the base bid. If any additional insulation needs to be replaced during construction, the additional quantities needed will be adjusted based on the unit prices provided on the bid form.
6. Wind Resistance Design Pressures.

B. Related Requirements:

1. Section 053100, Steel Decking
2. Section 061053, Miscellaneous Rough Carpentry
3. Section 070150.19, Preparation for Re-Roofing
4. Section 076200, Sheet Metal Flashing and Trim

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Pre-installation Roofing Conference: Conduct conference at Project Site. Mandatory attendance for roofing contractor, material manufacturer's technical representative, all subcontractors, project manager, and project foreman. Manufacturer must have a member at the pre-installation meeting who is trained as a technical advisor (not a salesperson).

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Contractor shall submit letter from manufacturer stating approval to install specified system and receive the 20-year warranty.
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
1. Base flashings and membrane terminations.
 2. Tapered insulation layouts, including slopes and minimum R-values.
 3. Insulation adhesive patterns for corner, perimeter, and field-of-roof locations.
- D. Samples for Verification: For the following products:
1. Sheet roofing, of color required.
 2. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.

- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and FM Global approved for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion in No Dollar Limit format.
 2. Contractor's warranty period: Three years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Johns Manville.
 2. Firestone Building Products.
 3. GAF.
- B. Source Limitations: Obtain all components for roofing system from manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- B. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a roofing system and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
- C. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class "A" for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- D. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.
- E. Wind Resistance Design: Installed roof assembly shall meet or exceed the following wind uplift pressures. The tested roof system shall include a Factor of Safety of 2 of the pressures listed below.

Roof Areas 15' Above Grade or Less:

1. Interior Field: 48 psf
2. Field: 74 psf
3. Perimeter: 94 psf
4. Corner: 123 psf

Roof Areas 20' Above Grade:

1. Interior Field: 50 psf
2. Field: 78 psf
3. Perimeter: 98 psf
4. Corner: 129 psf

2.3 TPO ROOFING

- A. Fabric-Reinforced TPO Sheet: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible TPO sheet.
1. Thickness: 60 mils, nominal.
 2. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content:
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Single-Ply Roof Membrane Adhesives: 250 g/L.

- f. Single-Ply Roof Membrane Sealants: 450 g/L.
 - g. Nonmembrane Roof Sealants: 300 g/L.
 - h. Sealant Primers for Nonporous Substrates: 250 g/L.
 - i. Sealant Primers for Porous Substrates: 775 g/L.
 - j. Other Adhesives and Sealants: 250 g/L.
- B. Sheet Flashing: Manufacturer's standard reinforced TPO sheet flashing, 60 mils thick, minimum, of same color as TPO sheet.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Separation Sheet: Manufacturer's recommended sheet to separate membrane from bitumen based products or any other incompatible material.
- E. Slip Sheet: Manufacturer's standard, of thickness required for application.
- F. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- G. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, pre-punched.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 ROOF INSULATION SYSTEM DESCRIPTION

- A. Base Bid and Alternate No. 2: Roof Areas A, B, C, C1, D, E, E1, E2, F, F1, G and H:
- 1. Insulation used to replace wet/damaged existing roof insulation is to be match existing in type and thicknesses. See core data information for specific insulation types.
 - 2. Cover Board – One layer of 1.0-inch thick polyisocyanurate roof insulation (unless required otherwise by the selected roof membrane manufacturer) mechanically fastened through the existing insulation system to the steel roof deck to withstand required wind uplift resistance.
- B. Alternate No. 1: Roof Areas I and J:
- 1. Insulation used to replace wet/damaged existing roof insulation is to be match existing in type and thicknesses. See core data information for specific insulation types.
 - 2. Cover Board – One layer of 1.0-inch thick polyisocyanurate roof insulation (unless required otherwise by the selected roof membrane manufacturer) mechanically fastened

through the existing built-up roof membrane system to the steel roof deck to withstand required wind uplift resistance.

- C. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 felt or glass-fiber mat facer on both major surfaces.
- D. Perlite Board Insulation: ASTM C 728; ¾ inch minimum.
- E. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

- A. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to prepared substrate or to another insulation layer.

2.7 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
- B. Install at all roof access points, around all mechanical equipment and where shown on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Excessive wrinkling of the newly installed roof membrane will not be acceptable regardless of whether acceptable to the manufacturer.
- B. Comply with roofing system manufacturer's written instructions.
- C. If there is a discrepancy between the specifications and the manufacturer's written instructions, the more stringent guideline shall be followed.
- D. Substrate-Joint Penetrations: Prevent adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.
- E. All roof penetrations are to be raised to a minimum flashing height of 8 inches prior to installation of roof insulation and roof membrane.

3.2 ROOFING INSTALLATION

- A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Single Ply Roofing".
- B. Clear the substrate of debris and foreign material.
- C. Wood nailers are required at all roof edge perimeter and at roof penetrations and must be flush with the top of the roof insulation.
- D. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- E. Recover roof systems:
 - 1. Remove all loose aggregate from the existing roof membrane by means of vacuum as required to leave a clean, dry, suitable substrate to receive the recover system. Any other preparation requirements of the roof system manufacturer such as separation sheets between bituminous materials, etc. shall also be strictly adhered to.
 - 2. After complete removal of all loose aggregate surfacing from the existing roof membrane, a minimum 6" core cut to the deck shall be made every 100 SF unless more are recommended by the roof system manufacturer.
 - 3. Removal of all existing base flashings and penetration flashings is also required. Removal of all bituminous materials and residue are required as recommended by the roof system manufacturer.
 - 4. Ensure that the finished roof surface and all transitions are smooth prior to installation of the new recover system.

3.3 ROOF INSULATION INSTALLATION

- A. Install roof insulation in accordance with manufacturer's guidelines and NRCA details.
- B. Polyisocyanurate installation:
 - 1. Board size shall be 4' x 4' for adhered applications and a maximum 4'x 8' for mechanically attached.
 - 2. Stagger all joints a minimum of 6" in both directions.
 - 3. Fit insulation neatly but do not jam in place. Insulation should lay free without gaps. Any gaps or openings greater than or equal to 1/4" shall be filled with similar insulation or replaced with new boards. Cut boards tight to walls, curbs, and penetrations.

4. Mechanically fasten all insulation to roof deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
5. Tapered shall be installed to provide positive drainage.
6. Contractor to verify electrical conduit that may exist within the interior of the structural framing and coordinate fastener lengths.

C. Cover Roof Board Installation:

1. Maximum board size is 4'x4'. Fasten insulation with a minimum of 8 fasteners per board unless recommended otherwise by the manufacturer or wind requirements. Use caution to prevent over driving fasteners and prevent the fasteners from stripping out.
2. Stagger all joints between the layers of insulation a minimum of 6".
3. Mechanically fasten through existing roof assembly/layers of insulation to roof deck.

3.4 MECHANICALLY FASTENED ROOFING INSTALLATION

- A. Mechanically attach roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before installation.
- B. Accurately align roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. In addition to mechanically attaching in the field of the roof area, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing. Roof membrane to be mechanically attached to resist wind uplift pressures.
- D. Apply roofing with laps shingled with slope of the substrate where possible.
- E. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.
 1. Test welds are to be taken daily to ensure proper weld is achieved. Test welds are to be saved for Consultant review.
 2. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
 3. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 4. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions. Provide separation membrane/sheets between new roofing sheet and existing materials that are not compatible with the roofing membrane.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products at all roof access points and around all curb mounted equipment. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.9 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: Horry County Schools.
2. Address: 335 Four Mile Road, Conway, SC 29526.
3. Building Name/Type: Waterway Elementary School.
4. Address: 700 Sandridge Road, Little River, SC 29566.
5. Area of Work: _____.
6. Acceptance Date: _____.
7. Warranty Period: _____.
8. Expiration Date: _____.

- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

- D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 73 mph;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;

- e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.

2. Name: _____.
3. Title: _____.

END OF SECTION

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

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. Sheet Metal Components to be included in the base bid, Alternate No.1 and Alternate No.2 are as follows:

- a. Skirt counterflashings at all curbs, roof expansion joints, area dividers and coping system.
- b. Sheet metal umbrellas
- c. Roof/wall counterflashings
- d. Modification of existing wall panels
- e. New wall panels – Alternate No. 1 only
- f. Wind clips
- g. Gutter and downspout system on Roof Area C1

2. Sheet Metal Components to be provided in Alternate No. 3 are as follows:

- a. Umbrellas
- b. Sheet Metal Copings
- c. Equipment Support Curb Caps
- d. Expansion Joint Covers
- e. Area Divider Covers
- f. Wind Clips
- g. Edge Metals
- h. Equipment support covers
- i. Area divider covers
- j. Overflow Scupper Liners and Face Plates
- k. All flashings/counterflashings

B. Related Requirements:

1. Section 061053 - Miscellaneous Rough Carpentry.
2. Section 075423 – Thermoplastic Polyolefin (TPO) Roofing.
3. Section 077200 - Roof Accessories.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leak-proof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include identification of material, thickness, weight, and finish for each item and location in Project.
- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested to withstand minimum wind uplift requirements.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install roof edge flashings and copings tested according to SPRI ES-1 and capable of resisting the required design pressures.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint

sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface. Minimum Thickness 0.040 inches.
1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Color: As selected by Owner from manufacturer's full range.
 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- C. Metallic-Coated Steel Sheet: Provide aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, prepainted by coil-coating process to comply with ASTM A 755/A 755M.
1. Surface: Smooth, flat and with manufacturer's standard clear acrylic coating on both sides.
 2. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Color: As selected by Owner from manufacturer's full range.
 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- D. TPO Coated Metal: Manufacturer's factory laminated TPO coated, 24 gauge galvanized (G90) steel sheet.

1. Edge Metals
2. Scupper Sleeves/Liners
3. Pitch Pan Flashings

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 40 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2 inch wide and 1/8 inch thick.

- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Obtain field measurements for accurate fit before shop fabrication.
 - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped joints unless otherwise indicated.
 - 3. Coping shall have one inch high locked standing seams.
- C. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal. Cleats shall be 1 gauge/increment thicker than sheet metal used.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- F. Seams: Fabricate nonmoving seams with flat-lock seams.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

- H. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Gutters and Downspouts: Gutters and Downspouts shall be sized as indicated on drawings.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Expansion Joints: Fabricate in sections not exceeding 10-feet. Use standing seams at all joint locations. Fasten inside leg with 1 ½" neoprene gasketed fasteners at 12" on center. Fasten sheet metal cleat leg with 1 ½" neoprene gasketed fasteners at 12" on center.
- B. Edge Metal: Fabricate in sections not exceeding 10-feet. Use cover plates at all joint locations. Furnish with continuous cleats to support edge of external leg and fabricated from 22 gauge/0.050 inch stock. Miter corners. Fasten horizontal leg of edge metal to wood nailers as required in details. External leg shall extend below bottom edge of wood nailer and the top of wall a minimum of 2".
- C. Copings: Fabricate in sections not exceeding 10-feet. Use standing seams at all joint locations. Furnish with continuous cleats to support edge of external leg and fabricated from 22 gauge/0.050 inch stock. Miter corners. Fasten inside leg with 1 ½" neoprene gasketed fasteners at 12" on center. External leg shall extend below bottom edge of wood nailer and the top of wall a minimum of 2".

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 4. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Underlayment: Where installing sheet metal flashing and trim directly on wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 2. Use standing seam expansion joints only.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 1-1/4 inches for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

3.3 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate.

- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 3 inches over base flashing. Install stainless-steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with sealant and clamp flashing to pipes that penetrate roof.

3.5 ROOF DRAIN FLOOD TEST

- A. Flood test roof drains after complete installation to ensure roof drains are watertight. The flood test shall not be performed if inclement weather threatens. Photo documentation of flood test shall be provided in close out documents.
- B. New Roof Drains: Temporarily plug each roof drain below roof drain connection and provide water in roof drain bowl stopping below the membrane/clamping ring connection. Allow a minimum of 1 hour for leakage to occur. If leakage occurs, make the proper repairs and retest until. Repeat test until no leakage occurs.
- C. All Roof Drains: Temporarily plug each roof drain and provide water 2 inches above the membrane/clamping ring connection. Allow a minimum of 2 hours for leakage to occur. If leakage occurs, make the proper repairs and retest until. Repeat test until no leakage occurs. Do not test if inclement weather is occurring or is forecast at the time of the test.
- D. Do not test if inclement weather is occurring or is forecast at the time of the test.
- E. Drain plugs are to be removed each day prior to leaving the project site.

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturers written installation instructions.

END OF SECTION

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SECTION 077200 - ROOF ACCESSORIES

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. Accessories to be included in the base bid and Alternate Nos. 1 - 2 are as follows:
 - a. Installation of roof walkways around all curb mounted equipment and at all roof access points based on the scopes of work selected.
 - b. Provide new cast iron clamping rings, strainers, and stainless-steel bolts at all roof drain locations based on the scopes of work selected.
 - c. Installation of prefabricated pipe supports for all horizontal pipes, condensate lines, etc. based on the scopes of work selected.
 - d. Weighted safety rail system (non-penetrating) to be provided between roof hatch and roof edge and between all HVAC equipment and the roof edge where the HVAC equipment is 10 feet or less from the roof edge as required by OSHA. A cage around a roof access hatch would not meet this requirement. This is to be included for all roof areas even if Alternates are not accepted.
 - e. Replace all existing roof access hatches with new based on the scopes of work selected. New roof access hatches to be of aluminum construction.
2. A unit price is to be provided for roof drain replacement and is to be used to replace damaged existing roof drains. A unit price is required to be provided to adjust the contract sum based on the actual amount used.

B. Related Sections:

1. Section 011000, Summary.
2. Section 075216, Thermoplastic Polyolefin (TPO) Roofing.
3. Section 076200, Sheet Metal Flashing and Trim.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof.
- B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 COORDINATION

- A. Coordinate layout and installation of roof accessories.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe Supports:
 - 1. Miro Industries Inc., Miro 1.5 Pillow Block Rooftop Pipe Support or approved equal.
- B. Walkway Material: Manufacturer's recommended walkway material installed to allow for positive drainage.

- C. Roof Drains and Roof Drain Components: Cast iron drain bowls with threaded connection, cast iron clamping rings and cast-iron strainers. All clamping ring drain bolts shall be stainless steel. All components and installation procedures shall adhere to the IPC 2018.
- D. Weighted Safety Rail System:
 - 1. Weighted safety railing systems shall be provided where curbs, roof hatches, or equipment are within 10' of the roof edge.
- E. Roof Hatch: Roof Hatch to be of aluminum construction and shall match the existing size and type.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 2. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Roof Drain Installation: Install roof drains with threaded pipe in the bottom of the roof drain. Pipe shall be connected to existing pipe below roof deck utilizing a coupling tightly fitting both new and existing pipes. Roof Drain heights shall be set based on the base layer of insulation, tapered insulation, and cover board extending under roof drain bowl.
- C. Pipe Support Installation: Install pipe supports so top surfaces are in contact with and provide equally distributed support along length of supported item. Pipe supports shall also allow for thermal movement. Pipe supports shall be provide at each change in direction and five feet on center. Pipe supports shall be provided at each gas line, condensation line, and electrical line

that exists on the roof surface. Walkpads shall be provided under each pipe support, adhered to the roof membrane.

D. Roof Walkway Installation:

1. Verify that locations of access and servicing points for roof-mounted equipment are served by locations of roof walkways.
2. Adhere walkways to roof membrane as necessary to keep walkway material in place and to resist curling. Join sections of the walkway material together using the same method.
3. Install of roof walkways around all curb mounted equipment and at all roof access points.

3.3 REPAIR AND CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.
- B. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 23 0501 - GENERAL HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. The Heating, Ventilation, and Air Conditioning (HVAC) work shall include, but not be limited to, the following:
 - 1. Piping for HVAC system
 - 2. Air Conditioning
 - 3. Refrigeration
 - 4. Air Distribution
 - 5. Controls and Instrumentation
 - 6. Balancing of Air Systems

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 DELINEATION OF WORK:

- A. Provide all necessary coordination of information to installers who are performing work to accommodate Division 23 installations.
- B. Where the Division 23 installer is required to install items which they do not purchase, they shall include for such items:
 - 1. The coordination of their delivery.
 - 2. Their unloading from delivery trucks driven in to any designated point on the property line at grade level.
 - 3. Their safe handling and field storage up to the time of permanent placement in the project.
 - 4. The correction of any damage, defacement or corrosion to which they may have been subjected.

5. Their field assembly and internal connection as may be necessary for their proper operation.
 6. Their mounting in place including the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.
 7. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
- C. Items which are to be installed by the Division 23 installer but not purchased as part of the work of Division 23 shall be carefully examined upon delivery to the project. The Division 23 installer shall provide all work necessary to properly install these items.
- D. If any items have been received in such condition that their installation will require additional work beyond the project scope of the work, the A/E shall be notified in writing within ten (10) working days of the date of delivery of the items. Any claims beyond 10 days will not be considered by the A/E.

1.4 QUALITY ASSURANCE:

- A. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service. Where no specific indication as to the type or quality of material or equipment is indicated, a first-class standard article shall be furnished. All manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Engineer, be able to furnish proof of their ability to deliver this equipment by submitting affidavits supporting their claim.
- B. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. ASME Code Ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- C. All equipment of one type shall be the products of one manufacturer unless specifically stated otherwise.
- D. Where the specifications do not list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.
- E. All materials with a manufacturers listed shelf life shall be used at least six months prior to the expiration of the materials' shelf life.

1.5 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Submit all items necessary to obtain all required permits to the appropriate Regulatory Agencies, obtain all required permits, and pay all required fees.
- B. Where Codes and Standards are referenced, they shall be the date stated in these specifications or on the drawings. If none stated, they shall be the latest edition.
- C. All work shall conform to the following Building Codes:
 - 1. International Building Codes
 - 2. National Fire Protection Association
- D. All work shall conform to all federal, state, and local ordinances.
- E. Where applicable, all fixtures, equipment, and materials shall be as approved or listed by the following:
 - 1. Factory Mutual Laboratories (FM)
 - 2. Underwriters Laboratories, Inc. (UL)
- F. All fuel fired equipment shall meet the requirements of the insurers and agencies listed and also meet the owner's insurer requirements.

1.6 STANDARDS AND PROCEDURES

- A. All work shall meet or exceed the standards and procedures of the following:
 - 1. ADC: Air Diffusion Council
 - 2. AMCA: Air Moving and Conditioning Association, Inc.
 - 3. ANSI: American National Standards Institute
 - 4. ARI: American Refrigeration Institute
 - 5. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
 - 6. ASME: American Society of Mechanical Engineers
 - 7. ASTM: American Society of Testing and Materials
 - 8. MSS: Manufacturers Standardization Society
 - 9. NEMA: National Electrical Manufacturer's Association
 - 10. OSHA: Occupational Safety & Health Administration

11. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
12. IRM: Improved Risk Mutuals

1.7 APPROVAL OF SUBSTITUTIONS:

- A. Specific reference in the specifications to any article, device, product, materials, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal", shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor in such cases may, at his option, use any article, device, product, material, fixture, form or type of construction which, in the judgment of the A/E expressed in writing, is equal to that named. Where quality and other characteristics are very nearly the same, the question of determining equal materials and readily available service sometimes resolves itself to a matter of personal opinion and judgment and in these and all other cases involving the approval of materials, the opinion, judgment and decision of the A/E shall be final and bind all parties concerned.
- B. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified shall be submitted for approval in writing ten (10) calendar days prior to bid opening date to the A/E. Requests shall be accompanied by samples, literature, and information as necessary to fully identify and allow appraisal of the material or equipment. Submittals shall be concise, clear, and brief as possible. Incomplete submittals or submittals requiring lengthy research to ascertain quality will not be considered.
- C. Approval of the A/E to use materials or equipment, if granted, will be in the form of a written addendum. Approved substitutions may be used at the Contractor's option. No substitutions will be allowed if substitutions are requested later than ten (10) days prior to bid opening date.
- D. Items approved shall not be construed as authorizing any deviations from the plans and specifications unless such deviations are clearly indicated in the form of a letter that is enclosed with the submittals. The Contractor shall be responsible for verifying all dimensions with available space. If, in the opinion of the A/E, the physical dimensions do not permit the substituted material or equipment to be properly operated, maintained, serviced, or otherwise accessed, or the physical dimension adversely impact other components, a system's ability to be operated, maintained, serviced or otherwise accessed, the material or equipment shall be replaced at the Contractor's expense.

1.8 VERIFICATION OF DIMENSIONS AND LOCATIONS:

- A. The Contractor shall visit the facility and become thoroughly familiar with all details of the work, working conditions, dimensions and clearances.
- B. Notify the A/E of any discrepancy between actual conditions and conditions indicated on the contract documents that could cause changes, other than minor ones, to the installation of any systems or equipment.

1.9 EQUIPMENT CONNECTIONS:

- A. The contract documents may indicate specific electrical, duct, and piping connection locations to equipment. Each manufacturer approved for bidding may have different connection arrangements. The Contractor is responsible for the modifications to and the extension of connecting components as required for the equipment provided.
- B. The Contractor shall bear all costs for required changes in connection to equipment.

1.10 WORKMANSHIP:

- A. Workmen shall be thoroughly experienced and fully capable of installing the work. Work shall be in accordance with the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to Owner.
- B. All material and equipment to be installed in accordance with manufacturer's printed recommendations using recommended accessories. Retain a copy on job site and submit others for approval when required.

1.11 GUARANTEES AND WARRANTIES:

- A. General:
 - 1. Furnish to the A/E a guarantee form, included in these specifications, signed by the Contractor and Owner agreeing to the start and end dates of all systems and equipment under warranty.
 - 2. All defective materials or inferior workmanship shall be replaced or repaired as directed by the Owner's representative during the guarantee period.
- B. Equipment Warranties:
 - 1. Equipment shall be warranted by the equipment manufacturer. Where labor is included in the warranty, the manufacturer, at their option, may permit the contractor to provide the required repairs on the equipment unless specified otherwise.
 - 2. The equipment manufacturer shall include a written guarantee with the closeout documentation.
- C. Duration Period:
 - 1. For work not otherwise specified, the duration shall be one year from substantial completion including all parts, labor, and other charges.
 - 2. The Contractor is responsible for purchasing from the equipment manufacturers any additional warranties to ensure that the equipment is warranted by the manufacturer through the duration period specified.

D. Extended Warranties:

1. Warranty periods shall be extended where specifically stated in these specifications.
2. The extended warranties shall meet the requirements of the base warranty unless specifically noted otherwise.
3. The extended warranty time listed is time in addition to the base warranty period.
4. The following systems or equipment shall be extended warranties:
 - a. All air conditioning compressors shall be provided with an extended 4-year warranty, including parts and delivery charges. Centrifugal and rotary compressors shall include motor, impeller or screw, and drive train.

E. Non-Warranted Items:

1. Non durable replaceable items such as air filter media do not require replacement after the date of acceptance.

F. Warranty Repair:

1. Repair shall take place as soon as possible but not later than the following:
 - a. Items not essential for facility operation - 7 days.
 - b. Items that have a small impact on facility operation - 2 days.
 - c. Items that have a significant impact on the facility operation - immediately begin repairs or work necessary to minimize operational impact to Owner.
2. The determination of the impact on the facility is solely that of the Owner and A/E.
3. Where life safety issues are impacted, the contractor shall take all steps necessary to ensure the facility can continue to function in a safe manner.
4. If repairs cannot be made in the required time period, temporary systems shall be installed until repairs can be completed.
5. All costs associated with warranty work shall be borne by the contractor.

1.12 WELDER REQUIREMENTS:

- A. All welders shall be certified by the Welding Bureau of the Mechanical Contractors Association of America. The welders shall be certified for type of welding procedure applicable to the project.

- B. Welding shall be performed in accordance to the applicable welding procedure specification (WPS). Separate WPS are required for different welding methods and materials as set forth in ASME Boiler and Pressure Vessel Code, Section IX.
- C. Welders, welding test and welding procedures shall comply with the following:
1. Applicable sections of ASME B31 standard, Code for Pressure Piping
 2. ASME Boiler and Pressure Vessel Codes
 3. Standard D9.1 for arc welded and braze welded duct
- D. The different type of welding processes include, but are not limited to:
1. SMAW (Shielded metal arc welding)
 2. GMAW (Gas metal arc welding or MIG)
 3. GTAW (Gas tungsten arc welding or TIG/Heliarc)
- E. The Contractor shall be prepared to provide the following tests and reports prior to beginning construction:
1. Qualification test of each welder prior to beginning construction.
 2. One sample of welding of each welder's work selected at random by A/E if requested during construction period.
- F. Submit welder qualifications to A/E.

1.13 EXISTING FACILITIES:

- A. The location of duct, pipe, fixtures, equipment and appurtenances for existing facilities are shown on plans to indicate the extent of work required. Exact condition shall be field verified by the contractor.
- B. Where working above existing ceilings, remove existing tile/grid and reinstall existing tile/grid as necessary. Any damaged tile/grid shall be replaced at the contractor's expense.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRIOR CONDITIONS:

- A. Prior to the installation of any equipment or system component, the Contractor shall review any prior work that has been completed to accommodate the equipment or system component to be installed.
- B. If the prior work does not make a proper installation of any equipment or system component possible, notify the A/E prior to installation of any equipment or system component.

3.2 INSTALLATION:

- A. Install all equipment and appurtenances in strict accordance with the manufacturer's recommendations and the manufacturer's shop drawings.
- B. If any equipment cannot be installed in accordance with Codes, contract documents, manufacturer's recommendations and accepted practices, notify the A/E in writing prior to installation of equipment.
- C. If any system component cannot be installed in accordance with Codes, contract documents and accepted practices, notify the A/E in writing prior to installation of the system component.

3.3 PROTECTION OF SYSTEMS AND EQUIPMENT:

- A. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage prior to final inspections, repair or replace damaged items as determined by the A/E, at no cost to the Owner.
- B. Store equipment on elevated supports and cover them on all sides with securely fastened waterproof coverings. All equipment openings shall be securely sealed.
- C. Piping shall be protected by storing it on elevated supports and capping the ends.
- D. During construction, all open ends of pipe, etc. which could collect construction debris shall be properly capped.

3.4 CLEANING OF SYSTEMS AND EQUIPMENT:

- A. All equipment and systems shall be cleaned of all extraneous materials to leave equipment and system finish in a new condition.
- B. Where equipment and systems cannot be properly cleaned, take all measures necessary to replace or repair equipment and systems to bring back to a "like new" condition. All costs shall be borne by the Contractor.
- C. All extraneous materials shall be removed on the site on a regular basis to provide access to all work as well as a safe working environment.

3.5 SUPPORT OF SYSTEMS:

- A. Hanging duct, piping, or equipment from un-reinforced metal decks (i.e., metal roof deck w/o concrete), etc. is not permitted.
- B. The following methods of support are not permitted:
 - 1. Wire hangers unless specifically indicated
 - 2. Perforated straps
 - 3. Vinyl or plastic straps

END OF SECTION 23 0501

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SECTION 23 0502 - COMMON HVAC MATERIALS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of the mechanical systems where shown on the drawings and specified hereinafter.

B. Description:

1. Rooftop curbs shall include all supports for rooftop equipment, pipe, duct, air handling equipment and accessories.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE:

- A. All work shall meet or exceed the standards and procedures (latest edition) of the following:
 1. AISC Steel Handbook
- B. All work shall be applicable by mechanics normally employed in the trade. All work shall be installed in accordance with the manufacturer's recommendations.
- C. Manufacturers:
 1. The following caulking manufacturers are acceptable:
 - a. TREMCO
 - b. Sonneborn - Contech
 - c. W. R. Meadows

PART 2 - PRODUCTS**2.1 GENERAL:**

- A. Unless specifically indicated otherwise, the following products or product accessories shall be provided with the indicated equipment:
 - 1. Filters shall be provided on all air systems to protect heat transfer components from outside air, building exhaust air or other airstreams that could foul heat transfer surfaces and elsewhere as indicated. Refer to Particulate Air Filtration specification.

2.2 SUPPORT RAILS:

- A. Required Locations:
 - 1. Provide support rail for all rooftop mechanical systems or components including, but not limited to, the following:
 - a. Horizontal ducts
 - b. Condensers
 - c. Elsewhere as indicated
- B. Height:
 - 1. Support rail shall be height indicated, 18 inches high, or 8 inches above top of finished roof, whichever is greater.
 - 2. Support rail shall be sloped as required to maintain a level surface for the duct.
- C. Support Rail Construction:
 - 1. Support rail construction shall be continuously welded, galvanized, and dual wall with internal insulation.
 - 2. Support rail width shall be 6" min.
 - 3. Curb caps shall be 16 gauge (min.) and continuously welded.
 - 4. Curb caps shall be galvanized.

2.3 CURBS:

- A. Adapter Curbs and Curb Extensions:
 - 1. Provide an adapter curb and curb extension on top of existing roof curbs.

2. Construction shall be similar to the support rail except single wall
3. Provide 1/8 inch gasket between curbs and unit.
4. Blanked off section of adapter curb, if any, shall be sloped 1/8" per foot away from unit.

B. Curb Extensions with Full Bottoms:

1. Curb extensions shall be provided with a full bottom panel on curb.
2. The panel must be braced or supported to prevent sagging.

2.4 CURB AND SUPPORT RAIL DESIGN:

- A. Curb and support rail shall meet or exceed the greater of the seismic requirements and wind load requirements for this project.
- B. Design shall be reviewed by a registered professional engineer licensed in the state in which the project is located. The engineer's seal and signature shall be indicated on the submittals.
- C. The design shall include but not be limited to:
 1. Weight of load
 2. Type of load (point load, center load, end reaction, etc.)
 3. Safety factor (minimum of 2)
 4. Curb support bearing (beam, joist, concrete roof, etc.)

2.5 DRAINS:

- A. General:
 1. Drain shall be full size of connections, size indicated on drawings, or 3/4" minimum, whichever is largest.
 2. Provide drains with deep seal p-trap for all equipment.

2.6 FASTENERS, ANCHORS, AND ACCESSORIES:

- A. Unless indicated otherwise, all fasteners, anchors, and accessories shall be metallic and manufactured in the United States.
- B. Materials provided shall be considered industry standard for commercial or industrial use.

- C. All materials shall be installed in accordance with the manufacturer's recommendations for the intent use and application.
- D. Materials installed outdoors and other areas exposed to ambient temperature or humidity shall be stainless steel or hot dipped galvanized.
- E. Unless otherwise specified or required by the manufacturer, bolts shall meet or exceed the following strengths:
 - 1. Proof Load: 74 ksi
 - 2. Yield Strength: 81 ksi
 - 3. Tensile Strength: 105 ksi

2.7 SEALANT:

- A. Exterior joint sealant shall be polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding.
- B. Penetrations and fire rated assemblies shall meet the requirements of the Firestopping and Smokestopping specification.
- C. Color shall be approved by A/E.

2.8 VOC's (ADHESIVES, SEALANTS, AND SEALANT PRIMERS):

- A. All adhesives, sealants, and sealant primers shall meet the latest requirements of LEED or Green Globes or the following, whichever has the lower values:
 - 1. Substrate Applications:
 - a. Metal to Metal - 30 g/L
 - 2. Specialty Applications:
 - a. PVC welding – 510 g/L
 - b. CPVC welding – 450 g/L
 - c. ABJ welding – 325 g/L
 - d. Plastic cement welding – 250 g/L
 - e. Adhesive primer for plastic – 550 g/L

- f. Sheet applied rubber lining – 850 G/L
- g. Contact adhesive – 80 g/L
- 3. Insulation:
 - a. Duct - 50 g/L
 - b. Piping - 50 g/L
- B. The VOC limits are g/L less water.
- C. Adhesives, sealants, and sealant primers shall comply with the South Coast Air Quality Management District (SCAQMD) Rule #1168.

PART 3 - EXECUTION

3.1 ROOF CURBS AND SUPPORT RAILS:

- A. Submit shop drawings with structural engineering calculations where a seismic design is required.
- B. Curb and support rail sizes and locations shall be coordinated with building and roofing installers.
- C. The Contractor shall set curb and support rail and coordinate roof flashing with roofing installer. Curbs shall be fastened to building structure by welding or fasteners as required by seismic design. Equipment, duct, piping, conduit, etc. shall be fastened to curbs and support rails as required by seismic design.
- D. Duct, pipe, and conduit shall be properly flashed and counter flashed weathertight to roof curb.
- E. Curbs, auxiliary curbs, and support rails shall be installed to maintain a level surface plus or minus 1/4 inch for length of curb and rail.
- F. Field verify the size of an existing curb prior to fabricating adapter curb and curb extensions.
- G. Field verify the slope of an existing curb prior to fabricating the adapter curb and curb extensions.
- H. Provide curb seal or gasket on all equipment curbs.

3.2 EQUIPMENT STORAGE:

- A. Facilities for storing materials and equipment shall be provided by the Contractor.

- B. All equipment and materials shall be protected from ambient conditions including freezing and exposure to sunlight when these conditions could affect the product.
- C. All stored items shall be elevated off slab or grade.

3.3 DRAINS:

- A. General:
 - 1. All horizontal gravity drain piping shall be installed with a uniform grade of not less than 1/8" per foot of fall in direction of flow except as noted otherwise.
- B. Equipment and Miscellaneous Drains:
 - 1. Run drain to roof drain, janitor sink, equipment room drain, or grade if not indicated otherwise on plans.

3.4 EQUIPMENT PENETRATIONS:

- A. Seal all openings into equipment resulting from installation of equipment such as conduit and flex.

3.5 EQUIPMENT INSTALLATION:

- A. Repair all insulation damaged during installation of equipment.

3.6 EQUIPMENT ATTACHMENT:

- A. Equipment shall be secured to the building or structure. Where equipment is provided with a method of attachment, that method shall be used to attach the equipment. Where equipment is not provided with a method of attachment, the contractor shall add gussets, angles, or similar material to the unit without affecting the performance or warranty of the equipment, which shall be used to attach the equipment.

END OF SECTION 23 0502

SECTION 23 0503 - DEMOLITION, PATCHING AND REPAIR

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the demolition of all mechanical equipment, piping, duct, and appurtenances where indicated or shown on the drawings and specified hereinafter.
2. Furnish all labor, materials, tools and equipment and perform all operations in connection with the patching and repair of building structure, finishes and building assemblies as specified hereinafter.

B. Descriptions:

1. Remove and dispose of existing HVAC equipment, piping, and appurtenances.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

PART 2 - EXECUTION

2.1 GENERAL:

- A. Post tensioned slabs, beams, columns and other load bearing structures shall not be drilled, cut, or otherwise modified without written approval by structural engineer.

2.2 PROTECTION:

- A. Provide barricades and take all other precautionary measures necessary to protect personnel and property.
- B. The Contractor shall be responsible for any damages to adjacent areas to the construction area.
- C. Protect the roof at all times. Provide planking, plywood, supports, and other materials and means to ensure damage is not incurred.

- D. At no time shall required means of egress be blocked by equipment materials, permanent or temporary barriers.

2.3 COORDINATION:

- A. All demolition work which will interrupt building utilities or cause the disruption of the normal environment in areas of the building not within the scope of this project will be performed at other than the Owner's normal working hours.

END OF SECTION 23 0503

SECTION 23 0510 - DOCUMENTATION AND CLOSEOUT

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. Furnish all labor, materials, tools and equipment and perform all operations in connection with the project documentation and closeout.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL:

- A. All reports, forms, and manuals shall be submitted to the A/E in triplicate unless additional copies are noted.
- B. Report, forms, and manuals are to be submitted as soon as possible, but no later than thirty (30) days after the earliest date they can be prepared.

3.2 OWNER TRAINING:

- A. The contractor shall schedule the training on equipment and systems at least 21 days before training is to take place. The contractor shall provide multiple dates and times for the training to allow the Owner to coordinate the schedules of their staff to be trained.
- B. The contractor shall provide all training aids, manuals, etc. for the Owner's staff at the training classes. These are in addition to whatever is required for the Operations and Maintenance manuals. The contractor shall coordinate the number required with the Owner but shall include a maximum of 8 sets for the training class.
- C. The person providing the training shall be thoroughly knowledgeable in the subject matter and shall be certified by the equipment or system manufacturer.

3.3 PROJECT JOB DRAWINGS AND AS-BUILT DRAWINGS:

- A. Keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of all items, material, and equipment on the project job drawings.
- B. At the time of final inspection, one corrected set of prints shall be delivered to the A/E. All drawing costs to be by the Contractor.
- C. As built drawings shall have the information transferred from the project job drawings including all addendum, supplemental instructions, change orders, and similar information.
- D. Qualified draftsmen shall perform this task.

3.4 OPERATING AND MAINTENANCE MANUAL:

- A. Compile and bind three (3) sets of all manufacturer's instructions and descriptive literature on all items of equipment furnished under this work. Additionally, provide this information on a CD in PDF format.
- B. Binder shall be hard cover, three-ring notebook, embossed with the name of the project, 11" x 8-1/2" with heavy duty rings. Maximum binder size shall be 2-1/2". Use multiple binders as necessary.
- C. The spine of the binder shall be titled "HVAC Operating and Maintenance Manual, Volume No. X," with the name of the project and the date under the title.
- D. The Operating and Maintenance Manual shall include the following:
 - 1. Cover sheet in each binder listing the architect, engineer, and all contractors. List addresses and contact information.
 - 2. List name, address and phone number of organization responsible for warranty work, if other than Contractor, and the specific work for which he is responsible.
 - 3. List name, address and phone number of the nearest sales and the nearest service organization for each product.
 - 4. Schedules of all equipment including identification tag numbers shown on plans cross referenced to field applied identification tag numbers.
 - 5. Performance Curves: For fans and similar equipment at the operating conditions.
 - 6. Lubrication Schedule: Indicating type and frequency of lubrication required.
 - 7. List of Spare Parts: Recommended for normal service requirements. Each piece of equipment shall have this list clearly marked or attached to this submittal.

8. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
 9. Instruction Books: May be standard booklets but shall be clearly marked to indicate applicable equipment and characteristics.
 10. Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.
 11. Automatic Controls: Diagrams and functional descriptions.
 12. All factory test reports where factory tests specified.
 13. All start-up reports for all equipment.
 14. Test and balance report.
 15. Filter size list for each piece of equipment. Identify filter type, size, efficiency, and equipment tag.
- E. The following diagrams, schematics, and lists shall be provided:
1. Automatic control diagrams
 2. Sequences of operation

3.5 ENGINEERING FIELD REPORTS AND FINAL INSPECTION REPORTS:

- A. The A/E will review the Contractor's work periodically throughout the project. A report will be submitted to the Contractor.
- B. The reports shall be responded to within ten days of receipt by the Contractor. Each item shall be addressed with comments written on the inspection report if possible. Contractor's response shall address the status of each item and all discrepancies.

3.6 OPERATION AND MAINTENANCE INSTRUCTIONS:

- A. After all final tests and adjustments have been completed, the Owner's Representatives shall be instructed in all details of operation and maintenance for the systems installed.
- B. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive.
- C. Fifty percent of instructions shall be in a formal classroom setting.
- D. Instruction shall be provided as follows:
 1. Equipment: Trained factory representative

2. System: Competent employee of the Contractor

3.7 CONTROLS OPERATION AND MAINTENANCE INSTRUCTIONS:

- A. Upon completion of Operation and Maintenance instructions, the Owner's representative shall be instructed in all details of operation and maintenance for the controls installed.
- B. Controls Operation and Maintenance Instruction shall include the entire control system including control sequences that are inherent to equipment provided by the Equipment Manufacturer. Provide sufficient personnel equipment, walkie-talkies, gauges, and other accessories for this work.
- C. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive.
- D. Fifty percent of instructions shall be in a formal classroom setting.
- E. Instruction shall be provided as follows:
 1. Controls System: Competent employee of the controls installer

3.8 ACCEPTANCE:

- A. Upon notification by the Contractor and after completion of Operation and Maintenance Instructions, the A/E will visit the project for a demonstration of the building system and an inspection of the completed work.
- B. Items which do not comply with the Contract Documents or which function incorrectly will be listed. The list will be provided by the A/E to the Contractor for correction of the installed work.
- C. After all corrections have been made, the Contractor shall notify the A/E who will recheck the systems for compliance of all items listed.

PART 4 - STANDARD FORMS

4.1 GENERAL:

- A. All forms shall be completely filled out by the Contractor prior to acceptance of the project by the A/E.

4.2 HVAC CLOSEOUT LIST:

| HVAC CLOSEOUT DOCUMENT PROJECT: Waterway Elementary School Roofing Replacement BGA PROJECT NO.: 21112 | | |
|---|---------------|----------|
| DOCUMENT | DATE REVIEWED | COMMENTS |
| Preliminary Test and Balance (Airside) | | |
| Test & Balance (Airside) | | |
| HVAC O&M Manuals (3 sets plus CD) | | |
| As installed Control Drawings | | |
| HVAC marked-up As-Builts (1 set red lined) | | |
| Factory Test Reports | | |
| Equipment Start-Up Reports | | |
| Filter List | | |
| Punchlist dated _____ | | |
| Punchlist dated _____ | | |
| Punchlist dated _____ | | |
| Walk-Through with Owner | | |
| | | |
| | | |
| NOTE: Not all closeout documents may be listed. See other sections of specifications for additional requirements. | | |

4.3 HVAC INSTRUCTIONS TO OWNER:

| HVAC INSTRUCTIONS TO OWNER | | | | | |
|---|---------------------|-------------------------|--------------------------------|-------------------|----------------------------------|
| PROJECT: Waterway Elementary School Roofing Replacement | | | | | |
| BGA PROJECT NO.: 21112 | | | | | |
| INSTRUCTIONS | DATE/TIME SCHEDULED | MINIMUM SPECIFIED HOURS | ESTIMATED HOURS OF INSTRUCTION | PERSONS ATTENDING | COPY OF SIGN-IN LIST SENT TO BGA |
| Controls | | 4 | | | |
| Packaged Units | | 4 | | | |
| Split System AC Units | | 2 | | | |
| HVAC General | | 4 | | | |
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| <p>NOTE: Not all instructions may be listed. See other sections of specifications for additional requirements. Up to 8 sets of training material required. Provide per number of persons indicated. Where no minimum specified hours indicated, training shall be provided as necessary for technician to provide the Owner a good understanding of the operation, function, and maintenance requirements of the equipment or system installed.</p> | | | | | |

4.4 HVAC SPARE MATERIALS:

| HVAC SPARE MATERIALS LIST PROJECT: Waterway Elementary School Roofing Replacement BGA PROJECT NO.: 21112 | | | |
|--|----------------|-------------|-----------------------------|
| ITEM | DATE DELIVERED | ACCEPTED BY | COPY OF RECEIPT SENT TO BGA |
| Spare Filters | | | |
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| NOTE: Not all spare materials may be listed. See other sections of specifications for additional requirements. | | | |

4.5 INSTRUCTIONS TO OWNER:

| OWNER INSTRUCTIONS SIGN-IN SHEET | | | | |
|---|------|-------|--------|-----------|
| PROJECT: Waterway Elementary School Roofing Replacement | | | | |
| BGA PROJECT NO.: 21112 | | | | |
| SYSTEM/EQUIPMENT: | DATE | TIME | | LOCATION: |
| | | START | FINISH | |
| | | | | |
| | | | | |
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| | | | | |
| | | | | |
| INSTRUCTORS (PRINT NAME AND SIGN) | | | | |
| 1. _____ | | | | |
| 2. _____ | | | | |
| ATTENDEES (PRINT NAME AND SIGN) | | | | |
| 1. _____ | | | | |
| 2. _____ | | | | |
| 3. _____ | | | | |
| 4. _____ | | | | |
| 5. _____ | | | | |
| 6. _____ | | | | |
| 7. _____ | | | | |
| 8. _____ | | | | |
| WRITTEN MATERIALS PROVIDED TO ALL ATTENDEES: _____ YES _____ NO | | | | |
| INSTRUCTIONS IN CLASSROOM: _____ YES _____ NO | | | | |
| INSTRUCTIONS IN FIELD: _____ YES _____ NO | | | | |

END OF SECTION 23 0510

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SECTION 23 0511 - SUBMITTALS

PART 1 - GENERAL

1.1 GENERAL:

- A. Refer to Division 1 specification for information and shop drawings and submittals requirements. When conflicts exist, the more stringent requirements shall apply.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 PREPARATION OF SUBMITTALS:

- A. Before preparing submittals, consult all contract drawings and specifications in detail, obtain manufacturer's recommended installation instructions, and have shop drawings prepared based on specific equipment and material intended for installation. Obtain all drawings and submittals from other trades as necessary to coordinate submittals.
- B. Sign all shop drawings indicating conformance with contract documents before submitting to the A/E.

1.4 SUBMITTALS:

- A. General:
 - 1. Submittals are required on all items of equipment and materials.
 - 2. Submittals shall include but not be limited to:
 - a. All requirements of Division 1.
 - b. Complete information pertaining to appurtenances and accessories.
 - c. Information properly marked with service or function identification as related to the project.
 - d. Where the submittal consists of catalog sheets displaying other items which are not applicable, the proper features shall be clearly identified.
 - e. External connections properly marked, as related to the specific use intended, on standard factory assembly and field installation drawings.

-
- f. All performance characteristics and physical characteristics.
 - g. Wiring and control diagram.
 - h. All requirements listed in the specific section of specifications.
 - i. Electrical data on all motors greater than one horsepower. Data shall include horsepower unit served, power factor, efficiency and product of P.F. x EFF.
- B. Field Fabricated Components:
- 1. When field fabricated components are permitted by the specifications, scaled detailed drawings shall be submitted, clearly showing the materials used, dimensions, sizes, and means of assembly.
- 1.5 SAMPLES:
- A. Samples shall be provided when specified or required by the A/E to check product acceptability or for coordination purposes.
 - B. Samples will not be returned and shall not be included in the total required on the project.
- 1.6 REVIEW OF SUBMITTALS:
- A. Review of shop drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless the Contractor has, in letter form, called attention to such deviations at the time of submission and secured written approval of the specific deviations.
 - B. Any materials and equipment listed which are not in accordance with the equipment shown on the schedule shall be of size and physical arrangement to allow unobstructed access, when installed, for routine maintenance, coil removal, shaft removal, motor removal and other similar operations. Deviation from the characteristics of that equipment or layout system components will not necessarily be cause for rejection. Review of submittal does not relieve the Contractor of his responsibility. Should an installation not meet the intent of the contract documents, the Contractor may be required by the A/E to modify or replace equipment or system components with all costs, direct and indirect, borne by the Contractor.
 - C. It is strongly recommended that the Contractor not purchase or install any equipment or system components prior to receipt of reviewed shop drawings.
 - D. Reviewed with notations on the submittal shall not prohibit the Contractor from purchasing equipment. If the Contractor does not comply with the notations, the submittal shall be deemed rejected.

1.7 EQUIPMENT DIMENSIONS AND WEIGHTS:

- A. The contract documents may indicate specific equipment dimensions. The Contractor is responsible for verification of the dimensions for the equipment submitted prior to submitting shop drawings. Equipment larger than the equipment indicated on the contract documents may not be acceptable by the A/E's.
- B. The contract documents may indicate specific equipment weights. The Contractor is responsible for verification of the weight of the equipment submitted prior to submitting shop drawings. Equipment weighing more than the equipment indicated on the contract documents may not be acceptable to the A/E.
- C. Equipment shall not exceed maximum weight indicated on the schedules. If the equipment weight exceeds that indicated on the schedule, even where the manufacturer is an approved manufacturer, that equipment can not be bid on for this project.
- D. If equipment is not acceptable to the A/E due to dimensions or weights exceeding those indicated on contract documents, the Contractor shall accept all responsibility and costs for providing equipment that meets the dimension and weight requirements of the contract documents.

1.8 ELECTRICAL CHARACTERISTICS:

- A. Electrical characteristics for mechanical equipment are generally indicated on the mechanical documents. The electrical documents generally indicate power and wiring requirements to each piece of mechanical equipment.
- B. It shall be the mechanical installer's responsibility to verify prior to submitting shop drawings that the equipment submitted meets the electrical requirements of both the mechanical and electrical documents. If there is a discrepancy, the contractor shall bring the discrepancy to the A/E's attention prior to submitting shop drawings.
- C. If the discrepancy is brought to the A/E's attention prior to ordering the mechanical equipment or electrical materials associated with that equipment, the A/E will issue additional instructions to the Contractor.
- D. If the discrepancy is not brought to the A/E's attention prior to ordering the mechanical equipment and electrical materials (i.e. Contractor does not verify electrical requirements), the Contractor shall be responsible for all costs except those that would have been incurred if the discrepancy was determined prior to ordering the mechanical equipment and electrical materials.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRODUCT SUBMITTALS:

- A. The following list may be used as a checklist for the contractor and A/E. All products may not be listed.

PRODUCT SUBMITTALS

| BGA NO. | PRODUCT | NO. | DATE | | STATUS | | | | ITEMS TO RESUBMIT | DATE ITEMS RESUBMITTED |
|---------|-----------------------------------|-----|------|-----|--------|-----|--------|------|-------------------|------------------------|
| | | | In | Out | App. | AAN | Resub. | Rej. | | |
| | Control Drawings & Sequences | | | | | | | | | |
| | Curbs and Supports | | | | | | | | | |
| | Ductless Split Systems (AC) | | | | | | | | | |
| | Insulation, Mastics, and Sealants | | | | | | | | | |
| | Metal Duct | | | | | | | | | |
| | Name of Test and Balance Agency | | | | | | | | | |
| | Packaged Equipment (Heat Pump) | | | | | | | | | |
| | Pipe and Fitting Material | | | | | | | | | |
| | Pipe Hangers and Supports | | | | | | | | | |
| | Pipe Shields | | | | | | | | | |
| | Seismic Products | | | | | | | | | |
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3.2 TEST AND REPORT SUBMITTALS:

- A. The following list may be used as a checklist for the Contractor and A/E. All tests may not be listed.
 - 1. System start-up
 - 2. Test and Balance Agency Construction report

3.3 CONTROL SUBMITTAL:

- A. Control submittals shall include the following:
 - 1. All information necessary for a clear representative of the system to be provided.
 - 2. All control components.
 - 3. Graphical representative of all systems to be controlled.
 - 4. I/O summary sheets.
 - 5. Floor plan indicating panels.
 - 6. Sequence of operation. All devices referenced in the sequence shall be indicated on graphic representation.
 - 7. Large scale (75% reduction maximum) of all control panel faces.
 - 8. Wiring diagrams including interface with equipment (terminal strip, contactor, etc.).
- B. All drawing submittals shall be CADD generated drawings.
- C. Submit a floor plan locating all thermostats, sensors, and control panels. Contractor must receive approval in writing before roughing in controls.

3.4 COORDINATION DRAWING SUBMITTAL:

- A. This section may not include all drawings required. See specific specifications for additional requirements. All drawings shall be drawn 1/4" = 1'0" minimum.
- B. Coordination Drawings:
 - 1. Provide dimensional coordination drawings of the following:
 - a. Mechanical elements:
 - 1) Rooftop duct

3.5 SHOP DRAWING SUBMITTAL COVER SHEET:

- A. A separate cover sheet shall be submitted with each product type (i.e., valves can be submitted together, etc.)

3.6 SHOP DRAWING SUBMITTAL COVER SHEET
(Provide one page for each group of shop drawings.)

PROJECT NAME: Waterway Elementary School Roofing Replacement BGA FILE NO. 21112-3-33

PRODUCT: _____ BGA SHOP DWG. No. _____

NOTE TO CONTRACTOR

1. All shop drawing comments by Buford Goff & Associates shall be complied with or the shop drawings shall be declared rejected.
2. If this form is not completed and signed by the Contractor and items 1 to 8 below are not answered YES or N/A, the shop drawings shall be declared rejected.
3. Dampers, grilles, valves, etc., are reviewed for characteristics but not for size and quantity. It is the Contractor's responsibility to verify sizes and quantity.

SHOP DRAWING SUBMITTAL (Contractor to complete this section)

1. Does the submittal comply with the contract documents? Yes No
If no, list all deviations on an attached page.
2. Have the electrical characteristics (i.e., volt/phase/amps, MOP, MCA, and connection location) been reviewed with the electrical schedules and the electrical circuit sizing meet the requirements of that equipment? Yes No N/A
3. Is product an approved manufacturer listed in the specifications or addendum? Yes No N/A
4. Does the product submitted meet the manufacturer's recommended service clearance for the space in which it is to be installed? Yes No N/A
5. Have the control components of the product been reviewed and do they meet with the requirements of the controls contractor? Yes No N/A
6. Have the equipment connections been reviewed (size and locations) and has the Contractor included all provisions to make the required connections? Yes No N/A
7. Has the seismic engineer reviewed and approved the method of connecting seismic restraints to equipment? Yes No N/A
8. Is the equipment within the weight limitations specified, if any? Yes No N/A

BGA'S SHOP DRAWING STAMP (Engineer to complete this section)

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Contractor is responsible for specific compliance with the information given in the Contract Documents; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades, and the safe and satisfactory performance of his work.

- Reviewed Reviewed as Noted Revise and Resubmit Revise and Resubmit Items Listed
 See attached for additional comments Reject

Comments: _____

_____ Reviewer: _____ Date: _____

END OF SECTION 23 0511

SECTION 23 0529 - HANGERS AND SUPPORTS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of supports and anchors on all piping and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0548 – Sound, Vibration, and Seismic Control for HVAC
 2. Section 23 0719 - HVAC Piping Insulation
 3. Section 23 2113 - HVAC Piping (General)

1.3 QUALITY ASSURANCE:

- A. Products not otherwise specified in these documents shall be furnished by the listed manufacturers and installed in accordance with the manufacturers recommendation.
- B. Products used shall be consistent with industry practice for use in commercial or industrial installation.
- C. Codes and Standards:
 1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
 - a. ANSI B31.3 - Pressure Piping
 - b. Factory Mutual
 - c. International Building Codes
 - d. Manufacturer's Standardization Society Documents, MSS-SP-58, MSS-SP-69

- e. Pipe Fabrication Institute, Standard ES-26
 - f. AISC Specification for the Design, Fabrication, and Erection of Structural Steel Buildings
- D. Manufacturers:
- 1. The following pipe hanger and support manufacturers are acceptable:
 - a. B-Line
 - b. Pipe Hangers and Devices Mfg. Inc.
 - c. Anvil International
 - 2. The following refrigerant pipe clamp manufacturers are acceptable:
 - a. IRP
 - b. Hydro-Zorb
 - c. Armafix

PART 2 - PRODUCTS

2.1 GENERAL:

- A. It shall be the Contractor's responsibility to provide an adequate pipe support system in accordance with recognized engineering practices using, where possible, standard, commercially available hangers, support, guides, anchors and accessories.
- B. Materials shall be selected to prevent electrolysis and minimize corrosion for the environment in which the product is to be installed.
- C. Hanger shall be sized for insulation to run through hanger, support, clamp, or guide.

2.2 SAFETY FACTOR:

- A. All attachments, rods, and accessories selected based on weight load shall be selected for a two times safety factor minimum.

2.3 SEISMIC RESTRAINTS:

- A. Where seismic restraints of components is required, attachments shall be per the requirements of the Vibration and Seismic Controls specifications.

2.4 PIPE HANGERS, SUPPORTS, AND ACCESSORIES - GENERAL (INDOOR):**A. General:**

1. Other finishes may be specified for specific applications.

B. Hangers:

1. Swivel loop hangers for insulated pipe shall be carbon steel with zinc electroplate finish.

C. Shields:

1. Shields shall be carbon steel with zinc electroplate finish.

2.5 PIPE HANGERS - INSULATED PIPING:**A. Basis of design manufacturer for pipe up to 2" - Swivel loop hanger with shield:**

1. Anvil Model No. 69 with 167 shield
2. At contractor's option, clevis hanger may be used.

2.6 PIPE HANGERS - NON INSULATED PIPE (COPPER):**A. Basis of design manufacturer for all pipe sizes - Swivel loop hanger:**

1. Anvil Model No. 69 (with PVC coating)

2.7 PIPE HANGER SPACING:**A. General:**

1. The maximum spacing for pipe hangers and supports shall not exceed those stated in these specifications or the hanger manufacturer's recommendations, whichever is less.
2. Where concentrated loads of valves, fittings, etc. occur, closer spacing will be necessary and shall be based on the weight to be supported and the maximum recommended loads for the hanger components.
3. Hangers shall be provided within 12" of each change of direction, at each valve, and at equipment connections.
4. Pipe not listed shall meet the spacing requirements of the manufacturer.

B. Copper Pipe and Tubing:

| <u>Size</u> | <u>Max. Span Ft.</u> |
|------------------|--------------------------|
| Less than 1-1/2" | 5 |

2.8 HANGER RODS:

- A. Threaded rods, if not indicated otherwise, shall be carbon steel with zinc electroplate finish.
- B. Where seismic restraints of components are required, rod sizes shall be per the requirements of the Mechanical Sound, Vibration, and Controls specifications.
- C. Rods shall be selected at 2x safety factor.
- D. Rod capacity based upon ASTM A107 at 650 degrees F is as follows:

| <u>Rod Dia.</u> | <u>Max. Load</u> | <u>Max. Load (@ 2 x SF)</u> |
|-----------------|------------------|-----------------------------|
| 3/8 | 610 | 305 |

2.9 CHANNEL SUPPORTS:

- A. General:
 - 1. Channel supports shall be utilized wherever practical and whenever a channel support provides a cleaner installation than individual attachments to the structure.
- B. Construction:
 - 1. Channel supports shall be 12 gauge minimum and dimensions as necessary to meet project conditions.
 - 2. Channels in conditioned spaces or in plenums above conditioned spaces shall be pregalvanized or powder coated carbon steel.
 - 3. Channels exposed to ambient conditions shall be hot dipped galvanized after fabrication, aluminum, stainless steel, PVC coated, or epoxy coated.
 - 4. Channels shall have holes, slots, knockouts, etc. as required by the Contractor.
- C. Clamps and Accessories:
 - 1. Clamps, accessories, fasteners, etc. shall generally be the same materials as the channel supports unless indicated otherwise.
 - 2. Pipe clamps for indoor pipe shall have a pipe cushion.

3. See refrigerant pipe clamps for refrigerant pipe.

2.10 REFRIGERANT PIPE CLAMPS:

A. General:

1. Horizontal refrigerant pipe may be supported by either of the following methods:
 - a. Provide a pipe insert at the point of support. See pipe insulation.
 - b. Provide refrigerant pipe clamp specified in this section.

B. Pipe Clamp:

1. Metal pipe clamp shall have an inner rubber cushioning.
2. Clamp shall be sized to allow refrigerant pipe with insulation to pass through the inner rubber cushioning.

C. Basis of design manufacturer shall be:

1. IRP Hydra-Zorb Klo-Shure Cushion Clamp

2.11 PIPE SHIELDS:

- A. Provide at all supports and hangers on insulated piping systems.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Contractor shall bear all responsibility for materials and workmanship as described in this section, and shall make sure that all hangers and supports are properly and permanently connected to building structure.
- B. All pipe supports shall be designed to avoid interferences with other piping, hangers, electrical conduits and supports, building structures and equipment.

3.2 SUBMITTAL:

- A. Manufacturer shall be responsible for reviewing all plans, specifications, and existing conditions to determine the types, quantities, and accessories required to provide a complete system of pipe support.
- B. Submit shop drawings for each product to be used and indicate where the product is to be installed.

- C. Submit detail of attachment method.

3.3 AUXILIARY SUPPORTS, ANCHORS, AND FASTENERS:

- A. Supports attaching to steel structure shall be by bolting or clamping without penetrating structural member. Welding is not permitted without written permission.
- B. All fasteners shall be provided which resist loosening from vibration.

END OF SECTION 23 0529

SECTION 23 0548 – SOUND, VIBRATION, AND SEISMIC CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of mechanical sound, vibration, and seismic control required on all mechanical equipment, systems, and appurtenances where shown on the drawings and specified hereinafter.

- B. All foundations and supports of Division 23 equipment shall be furnished and installed by Division 23.

- C. er except where specifically noted otherwise.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. All seismic equipment and design shall comply with all local codes and ordinances and meet or exceed the standards and procedures (latest editions) of the following:

- a. International Building Codes
- b. SMACNA Seismic Restraint Manual
- c. ASHRAE
- d. ASTM E 488 (Anchor locations)

B. Manufacturer:

1. The following acoustical barrier manufacturers are acceptable:

- a. Kinetics

- b. Acoustiblok
- c. Aerosonics
- d. Sound Seal

PART 2 - PRODUCTS

2.1 GENERAL:

A. Components not exposed to ambient:

- 1. Steel components shall be powder coated. All nuts, bolts, and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

B. Components exposed to ambient or inside air handlers:

- 1. All components shall be PVC coated steel, hot-dip galvanized, stainless steel, or heresite coated.

2.2 ACOUSTICAL BARRIERS:

A. General:

- 1. Barrier is suitable for below rooftop equipment curb.
- 2. Acoustical barrier shall be a 2.0 lb. per square foot, reinforced material. Tensile strength shall be 510 lbs. per in. Material shall be waterproof.
- 3. Sound transmission loss shall be STC 32.
- 4. Basis of design manufacturer shall be:
 - a. Acoustiblok

B. Systems requiring acoustical barriers:

- 1. Provide a minimum sound transmission lost of STC 48 in the rooftop unit curb and pipe chase for the following rooftop units:
 - a. SPHP-1
 - b. SPHP-2

2.3 SEISMIC DESIGN:

A. General:

1. Specifications and plans shall indicate minimum requirements and general intent. The actual requirements shall be determined by the contractor's seismic system engineer but those requirements shall not be less than indicated on the plans and in these specifications.
2. The seismic engineer shall be a professional engineer registered in the state in which the facility is to be constructed and whose principal area of practice is in seismic engineering and related fields. The engineer shall be in the full time employment of the company submitting the product. The seismic engineer shall be responsible for:
 - a. Submittals (drawings and calculations)
 - b. Seismic Quality Assurance Plan
 - c. Certificates of Compliance
3. Where pipes, ducts, conduit, and similar systems cross the seismic isolation interface between two seismically isolated structures, the pipes, ducts, conduit, and similar systems shall have flexible connections to accommodate the seismic displacement of the structures. Typically, this will include flexible connections on one side of the interface.
4. The following mechanical components, except ceiling mounted mechanical components, shall be exempt from seismic design:
 - a. All components in seismic design category A and B.
 - b. All components in seismic design category C where $I_p = 1.0$.

B. Duct Systems:

1. Seismic restraints are required for all ducts unless specifically indicated otherwise.
2. The following duct shall be exempt from seismic design:
 - a. Duct with an $I_p = 1.0$ and with a cross-sectional area of less than 6.0 SF.
 - b. Duct with an $I_p = 1.0$ and installed 12 inches or less from the point of connection to the supporting structure above to top of duct (excluding insulation or any other coverings) for full length of duct run (duct run is up to change of direction of more than 2 times duct width in degrees).

- C. Components in Duct Systems:
1. Components and equipment installed in the duct system having flexible duct connections at one or more ends and weighing 20 pounds or less may be considered part of the duct system.
 2. Components and equipment installed in the duct system having no flexible duct connection and weighing 75 pounds or less may be considered part of the duct system.
 3. Connections to components and equipment in the duct system (i.e., hydronic or steam coils, electrical conduit, central conduit, etc.) shall accommodate differential movement utilizing type of flexible connection indicated on drawings or elsewhere in the specifications. If none indicated, flexible connection may be:
 - a. Flexible connector
 - b. Swing joints
 - c. Multiple elbows
 4. All components and equipment greater than 20 pounds with flexible duct connectors or greater than 75 pounds shall be independently supported and seismically restrained independently of the duct system.
- D. Piping Systems:
1. Seismic restraints are required for all pipes unless specifically indicated otherwise.
 2. Seismic restraints are not required for the following pipe provided the pipe is installed where it is protected from impact or will avoid the impact of larger pipe or equipment:
 - a. Pipes are supported by clevis or roller hangers and installed 12 inches or less from the point of connection to the supporting structure above to the top of the pipe (excluding insulation or any other coverings).
 - b. Pipes are supported by trapeze or roller support and are installed 12 inches or less from the point of the supporting structure above to the top of the trapeze or part of the roller support supporting the pipe.
 - c. High deformity piping in Seismic Design Category C, $I_p = 1.5$ or $I_p = 1.0$, and a nominal pipe size of 2 inches or less.
 3. Other piping systems shall meet or exceed the requirements of the IBC and the listed standard (whichever is greater):
 - a. Refrigeration Piping - ASME B31.5

E. Importance Factor (I_p):

1. Importance factor for mechanical components shall be $I_p = 1.0$ unless indicated otherwise.

2.4 WIND LOAD DESIGN:

A. General:

1. Specifications and plans shall indicate minimum requirements and general intent. The actual requirements shall be determined by the contractor's structural engineer but those requirements shall not be less than indicated on the plans and in these specifications.
 2. The structural engineer shall be a professional engineer registered in the state in which the facility is to be constructed. The structural engineer shall be responsible for:
 - a. Submittals (drawings and calculations)
 3. All equipment located outdoors shall be designed to meet or exceed the requirements of the current IBC wind load requirements.
 4. Calculations shall be based on the ASCE determined design pressure, exposure class, building height, and building type.
- B. All rooftop curbs shall be anchored sufficiently to the roofing members to withstand the IBC wind load requirements.
- C. Where additional bracing or tie downs are required, they shall be provided at no additional cost to the Owner.
- D. Coordinate the restraints required for wind loading with the seismic and vibration requirements indicated on the drawings and specifications.

2.5 ANCHORAGE TO BUILDING STRUCTURE:

A. General:

1. Anchorage to the building structure shall meet the requirements of the latest edition of:
 - a. International Building Code (Chapter 19)
 - b. ASCE Standard 7 (Chapter 13)
 - c. American Concrete Institute (ACI) 318

2. Requirements of this section of specifications are minimum requirements. When other requirements are indicated, the greater requirement shall be met or exceeded.
- B. Anchorage in Concrete or Masonry:
1. Calculation of anchorage forces shall be provided by the seismic engineer for all installations in Seismic Design Category C, D, E, and F.
 2. The following anchorage and attachments are not permitted:
 - a. Power driven fasteners for tension load applications in Category D, E, and F unless specifically approved for this application.
 - b. Friction clips.
- C. Post Installed Anchors:
1. Post installed anchors for Seismic Design Category C, D, E, and F shall meet the requirements of ACI 318.
- D. Threaded Rod Supports:
1. Rod supports shall be designed to resist bending moments.
 2. Threaded rod supporting duct, piping, equipment, or other components shall connect to structure by use of a swivel, eyebolt, vibration isolation hanger or other connection

2.6 VIBRATION AND SEISMIC ACCESSORIES:

- A. Provide all necessary brackets, bolts, fasteners, predrilled bases, oversized bases, accessory components and materials to install systems in accordance with manufacturer's requirements.

PART 3 - EXECUTION

3.1 GENERAL:

- A. If the equipment to be mounted or restrained is not furnished with integral structural frames and external mounting lugs (both of suitable strength and rigidity), approved members shall be installed in the field which shall provide means of attaching required vibration and seismic devices.
- B. The members include, but not limited to the following: gussets, rails, brackets, angles, channels and similar components. These members should be sized by the vibration and seismic vendor to provide an acceptable installation.

- C. All field installed components shall be neatly installed and be of materials and/or finish suitable for the installation.

3.2 SUBMITTALS (SEISMIC LOAD):

A. Seismic Restraints:

1. Submit drawings showing seismic loading, location of bracing, and types and sizes of bracing assemblies. The level of detail and information provided shall be similar to those included in the "SMACNA Seismic Restraint Manual."
2. Submit seismic protection ratings in three principle axes certified by an independent laboratory.
3. Submit calculations for shear, pull-up, primary overturning, and secondary overturning.
4. Submit drawings indicating auxiliary supports and method of attachment.
5. Submit drawings indicating size and type of attachment (i.e., welding, bolting, etc.) to:
 - a. Roof curbs to building structure.
 - b. Attachment of equipment to adapter curb and extension curb to the existing curb.
6. Submittals for seismic snubbers shall also include detailed drawings of steel sole plates and all anchorage to building structure including welding, bolting, and other methods of attachment. Submittal shall clearly indicate location of attachment and structural members.

B. Attachments and Connections:

1. Submit drawing indicating type of connection (i.e., clamp, eye bolt, swivel, etc.) to:
 - a. Beams
 - b. Joists
 - c. Structure members
2. Submit drawings indicating type of attachment (welding, bolting, etc.) to:
 - a. Structural members
 - b. Components or equipment

- C. Calculations shall be submitted and signed by a licensed professional engineer in the state where the project is located.

3.3 SUBMITTALS (WIND LOAD):

- A. Submit drawings and calculations showing wind loading, location of anchors, ties and bracing, and types and sizes of restraints.
- B. Submit drawings showing auxiliary supports and method of attachment.
- C. Submit drawings and calculations showing the attachment of equipment to curbs.
- D. Submit drawings and calculations showing the attachment of curbs to the structure members.
- E. Submit drawings and calculations showing the attachment of equipment to adapter curb and adapter curbs to existing curbs.

3.4 ACOUSTICAL BARRIERS INSTALLATION:

- A. Below rooftop curb:
 - 1. Seal to inside of roof curb and to all penetrations to completely isolate rooftop equipment.

3.5 SUPERVISION:

- A. The manufacturer, or his qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Upon completion of the installation and after the system is put into operation, the manufacturer, or his representative, shall make a final inspection and submit his report to the A/E in writing certifying the correctness of installation and compliance with approved submittal data.

3.6 INSTALLATION:

- A. Where field conditions, construction schedule, or construction progress require that isolators be installed after the equipment or systems are installed, provide temporary supports until that time when isolators can properly be installed.

3.7 EXISTING CURBS:

- A. After the existing unit is removed from the existing curb, the seismic engineer shall determine the best method to secure the existing curb to the existing building structure to meet the HVAC system's seismic requirements.
- B. Beam clamps and other friction type clamps shall have restraining straps for all items requiring seismic installation.

END OF SECTION 23 0548

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of mechanical identification on all mechanical equipment, systems, and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. All work furnished and installed shall comply with all local codes and ordinances and shall meet or exceed the standards and procedures (latest editions) of the following:
 - a. ANSI A13.1 for the identification of piping systems.
 - b. ANSI/NEMA Standard Z535.1.

B. Manufacturer:

1. The following band, tag, nameplate, and identification marker manufacturers are acceptable:
 - a. Seton Name Plate Corporation
 - b. T&B/Westline Products
 - c. Brady
 - d. MSI
 - e. Brimar

PART 2 - PRODUCTS

2.1 NAMEPLATES:

A. General:

1. Nameplates shall be black plastic with white engraved lettering.
2. All information shall be provided on a single nameplate per device if practical.
3. Nameplates shall have screw holes and screws for mounting unless screws would damage the intended use of the product to which it is attached (i.e., NEMA4 panel, etc.). In that case, provide stick-on nameplates.
4. Nameplates shall be 1/16" thick.

B. Size:

1. Two inch (2") high nameplate when located on outdoor HVAC equipment.

2.2 MECHANICAL EQUIPMENT:

A. Devices to be identified include all mechanical equipment.

B. Nameplate shall include (example):

1. Equipment description: EF #1, etc.
2. Owner's identification number

2.3 PIPE CODING (STICK ON):

A. Apply color coded polyvinyl chloride pipe bands identifying service and bands identifying direction of flow on all piping systems.

B. Bands shall be plenum rated.

C. Pipe identification sizing shall be:

| OUTSIDE DIAMETER OF PIPE OR COVERING | LENGTH OF COLOR FIELD INCHES | SIZE OF LETTERS INCHES |
|--|------------------------------------|------------------------------|
| 3/4 to 1-1/4 | 8 | 1/2 |
| 1-1/2 to 2 | 8 | 3/4 |
| 2-1/2 to 6 | 12 | 1-1/4 |

D. Markers shall be self-sticking type.

PART 3 - EXECUTION

3.1 PIPE CODING:

- A. On exposed piping apply bands at 20 foot centers on straight runs, at valve locations, and at points where piping enters and leaves a partition, wall, floor or ceiling.
- B. On concealed piping installed above removable ceiling construction, apply bands in the manner for exposed piping.
- C. Follow manufacturer's instructions for application procedures using noncombustible materials and contact adhesives.

3.2 NAMEPLATES:

- A. Submit listing of all nameplates with associated information to A/E for approval before fabrication.
- B. Coordinate method of attachment and location of nameplate with contractor who is responsible for the installation of the device (i.e., control panel, air handler, etc.).

END OF SECTION 23 0553

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SECTION 23 0592 - SYSTEM START-UP

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the start-up of all building mechanical systems where shown on the drawings and specified hereinafter.

B. Description:

1. These systems shall include:
 - a. Air systems
 - b. Refrigeration systems

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:

1. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC

1.3 QUALITY ASSURANCE:

A. Codes and standards:

1. All work shall meet or exceed the standards and procedures of the following (latest edition):

- a. AABC National Standards
- b. SMACNA

- B. Start-up of equipment shall be by manufacturer's representative unless noted otherwise.

- C. Tests, in addition to those specified herein, required to prove code compliance, to meet insurance requirements, and to verify proper installation by the A/E, owner, or authorities having jurisdiction shall be provided by the Contractor.

- D. All tests, instruments, and procedures shall be in accordance with the AABC National Standards and system test and balance specifications.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All concealed work must remain uncovered until required tests have been completed. Sections of the system may be tested prior to concealing as outlined hereinafter.
- B. The Owner and the A/E shall be notified in writing a minimum of three working days prior to any tests being performed.
- C. Local, state and federal authorities having jurisdiction shall be notified in writing with sufficient time to schedule inspection as required by the authority.
- D. In no case shall a system be started or operated in such a manner that the system or component pressure or temperature ratings, or the pressure or temperature to which a system or component has been tested, be exceeded.

2.2 START-UP:

- A. Systems shall be started up by the Contractor except as required in specific portions of the mechanical specifications.
- B. The following systems shall be started up by a factory certified technician:
 - 1. Heating and air conditioning equipment

2.3 STARTING THE PIPING SYSTEMS:

- A. Prior to putting any piping system in service, it shall be tested and thoroughly cleaned according to the procedures as specified below and as required by the equipment manufacturer, whichever requirement is more stringent.
- B. Dehydration of Refrigerant Piping Systems:
 - 1. Dehydrate refrigerant piping systems using a vacuum pump with check valve.
 - 2. The systems shall be evacuated to 500 microns or to whatever level required by equipment or system manufacturer, whichever is more stringent, and held there for three hours.
 - 3. The vacuum shall be broken with dry refrigerant.
 - 4. After approved by the third party inspector, fill the system with its operating charge of refrigerant.

2.4 PIPING SYSTEM TESTS:

A. General:

1. Upon completion of each system of work under this Division and at a designated time, all piping shall be pressure tested for leaks.
2. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests repeated at no additional cost to Owner. Make tight any leaks. Repeat tests until system is proven tight. Caulking of leaks is not permitted.
3. All equipment not capable of withstanding the test pressure shall be valved off during test.
4. Provide all gauges, valves, caps and accessories to properly test system.
5. At no time shall a system be tested at a pressure greater than the piping system or component is rated.

B. Refrigerant Piping:

1. Refrigerant piping shall be tested in accordance with the equipment manufacturer's recommended pressure.
2. All joints and equipment shall be leak tested using a halide or electronic leak detector.
3. The test shall be for the length of time recommended by the manufacturer or thirty minutes, whichever is greater, without leakage.

2.5 SYSTEM START-UP:

A. General:

1. System shall be started and checked to ensure safe and proper operation.
2. Minimum requirements are listed for each system and are in addition to manufacturer start-up requirements and the requirements stated in the specific sections of the specifications.
3. Temperature control systems installed complete and operable.
4. Proper thermal overload protection in place for electrical equipment.

B. Air Systems:

1. Verify proper fan rotation.
2. Verify full load amps are below nameplate amps.

3. Verify control dampers operating.
4. Verify balance dampers are open.
5. Remove all duct restrictions.
6. Verify clean filters are installed.

PART 3- EXECUTION

3.1 SUBMITTALS:

- A. Submit to the A/E all test results including a minimum of the following information:
 1. System tested
 2. Location of test
 3. Date, time, and ambient temperature at test startup and completion
 4. Persons present for test
 5. Duration of test
 6. Test equipment
 7. Test results
- B. Reports shall include but not be limited to:
 1. Tests during construction
 2. Manufacturer's factory test reports
 3. Equipment start-up reports
- C. Reports shall be submitted within ten days of test completion.

3.2 ENGINEER REVIEW:

- A. The A/E shall, at his discretion, recheck any or all of the test work. Provide ample number of technicians and test equipment to perform the tests required.
- B. All systems not accepted shall be retested.
- C. Systems shall be retested and rechecked until accepted by all parties.

END OF SECTION 23 0592

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the testing and balancing of all mechanical systems where shown on the drawings and specified hereinafter.

B. Description:

1. Systems shall include all equipment, operators, controls, accessories, and appurtenances.
2. These systems shall include:
 - a. Air systems

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:

1. Section 23 0592 - System Start-Up

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures of the following (latest editions):

- a. AABC National Standards
- b. NEBB Standards
- c. NBC Standards

2. Testing and balancing shall be performed by an agency certified by the AABC, NEBB, or the National Balancing Council.

3. All technicians shall have a minimum of three years testing and balancing. Each test and adjustment shall be under the direct supervision of a qualified technician.
4. Testing and balancing shall be performed by one agency.

PART 2 - PRODUCTS

2.1 GENERAL BALANCING PROCEDURES:

- A. All recorded data shall represent a true, actually measured, or observed condition.
- B. Any abnormal conditions in the mechanical systems or conditions which prevent total system balance, as observed by the Test and Balance Agency, shall be reported as soon as possible to the A/E.
- C. If, for any reason, a system cannot be properly balanced, it shall be reported to the A/E by the Test and Balance Agency as soon as observed.
- D. Should additional balancing devices be required, the Test and Balance Agency shall bring it to the attention of the Contractor as quickly as possible.
- E. The Test and Balance Agency shall leave all system components in proper working order including:
 1. Close access doors.
 2. Close doors to electrical switch boxes.
 3. Restore thermostats to specified settings.
- F. The Test and Balance Agency shall permanently mark the settings of all dampers and other adjustment devices in a manner that will allow the settings to be restored. If a balancing device is provided with a memory stop, it shall be set and locked.
- G. Systems shall be tested in each specified mode of operation. See equipment Sequence of Operation.

2.2 INSTRUMENTS:

- A. All Test and Balance work shall be performed using the required instrumentation to obtain proper measurements.
- B. Instruments shall be properly maintained and transported in such a manner as to provide protection against damage due to vibration, impact, moisture or any other condition that may render them inaccurate.
- C. Instruments shall have been calibrated within a period of six months prior to starting the project.

- D. Proof of calibration shall be maintained with the instruments.
- E. Instruments shall be calibrated upon completion of the work when required by the client to prove reliability.

2.3 AIR SYSTEMS:

A. General Requirements:

1. Total system balance shall not begin until the Test and Balance Agency has verified that start-up procedures have been performed and filters have been changed.
2. The Test and Balance Agency shall measure the amperes of all fan motors before total system balance is started and shall take proper steps to correct and report any overloads.
3. The Test and Balance Agency shall not continue total system balance if any conditions are observed that are hazardous to the air system. This shall be reported and corrected before proceeding further.
4. The Test and Balance Agency shall verify all outlets for compliance with design requirements and shall report any variations before starting total system balance.
5. If during total system balance, the Test and Balance agency detects any inlet or outlet conditions that will not allow proper balancing to be performed, the A/E shall be notified immediately.
6. Reports shall indicate airflow measured at unit and inlet and outlet totals.

B. Air Outlets:

1. The systems shall be balanced so that the total supply air quantity to each space shall be within -5% to +5% of the design amount.
2. The pattern for all adjustable outlets shall be adjusted for proper distribution to minimize drafts.
3. Outlet dampers shall not be used to provide proper branch airflow to space.

C. Air Inlets:

1. Inlets on systems shall be adjusted to the required quantities with a tolerance of $\pm 5\%$.
2. At completion of total system balance, at least one inlet of every branch shall be fully open and at least one branch balancing damper in the system shall be fully open.

D. Zone Dampers:

1. Dampers installed in main trunks and branches and dampers required for system control shall be balanced within -5% to +5% of the design amount.

E. Filters:

1. Under final balanced conditions, the Test and Balance Agency shall measure and record static pressure entering and leaving each filter bank.

F. Fans:

1. The Test and Balance Agency shall set the fan RPM to provide design total CFM and the required static pressure to operate the system.
2. Fan speed shall not exceed the maximum allowable RPM as established by the fan manufacturer.
3. The final setting of fan RPM shall not result in overloading the fan motor in any mode of operation. Dampers shall be modulated, and the amperes of the supply fan motor shall be measured to ensure that no motor overload can occur. The amperes shall be measured in the full cooling, heating, and dehumidification modes to determine the maximum brake horsepower.
4. After total system balancing, the following values shall be recorded:
 - a. Fan RPM
 - b. Motor voltage and amperes
 - c. Entering static pressure
 - d. Leaving static pressure
5. Final RPM of the constant volume supply fan shall be set to supply the required CFM with filters artificially restricted to simulate 100% loading. The Test and Balance Agency shall verify that the fan motor will not be overloaded when the system is operating with unrestricted, clean filters in place.
6. When applicable, final supply fan settings shall be based on rated wet cooling coil resistance.

G. Static Pressure Readings:

1. Static pressure leaving the fan shall be taken as far downstream from the fan as is practical, but shall be upstream of any restrictions in the duct (such as duct turns).
2. No reading shall be taken directly at the fan outlet or through the flexible connection.
3. Static pressure entering a fan shall be measured in the inlet duct upstream of any flexible connection and downstream of any duct restrictions.

2.4 TEMPERATURE CONTROL SYSTEM:

- A. In the process of Total System Balance, the Test and Balance Agency shall:
1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding to intended control performance.
 2. Verify that all control devices are properly connected.
 3. Verify that all dampers and other controlled devices are operated by the intended controller.
 4. Verify that all dampers are in the position indicated by the controller (open, closed, or modulating).
 5. Verify the integrity of dampers in terms of tightness of close-off and of full-open position.
 6. Check the calibration of all controllers.
 7. Verify the proper application of all normally open and normally closed valves.
 8. Check that the sequence of operation for any control mode is in accordance with approved shop drawings. Verify that no simultaneous heating and cooling occurs except where specified.
 9. Verify that all controller set points meet the design intent.
 10. Check all dampers for free travel.
 11. Verify the operation of all interlocked systems.
 12. Perform all system verification to assure the safety of the system and its components.

2.5 EXISTING SYSTEMS:

- A. General:
1. All air systems which are to remain but are modified in any manner or are listed to be tested shall be tested before demolition begins.
- B. Balancing Requirements
1. The A/E shall provide direction on any changes to be made to the existing equipment's air balance. After renovation work is completed, the existing equipment shall be rebalanced or, if no changes are required, equipment shall be retested.

C. Reports:

1. A test and balance report shall be submitted before demolition and after renovation is completed for all systems which are required to be measured.

2.6 TEMPERATURE MEASUREMENT:

A. General:

1. Where outside air temperature is a variable affecting other readings (such as a mixed air temperature), the outside air reading shall be given at the time of the mixed air reading.

B. Air Temperatures:

1. Provide entering and leaving air temperatures for each cooling coil, heating coil, and heat transfer device.
2. Temperatures shall be measured in heating, cooling, dehumidification, and neutral modes of operation.

PART 3 - EXECUTION

3.1 SUBMITTALS:

- A. The Contractor shall submit to the A/E the following information within thirty days after the award of the contract:
 1. The name of the Test and Balance Agency.
 2. Name and registration number of the certified testing technician.
- B. The Contractor shall submit to the A/E the following information within ninety days after the award of the contract.
 1. Detailed testing procedures including list of instruments, task performed, model and serial number and date last calibrated.
 2. Agenda including schedule of work with approximate duration of each phase, approximate date of field inspections, and required start date to meet scheduled completion date.
 3. Report forms.
- C. An approved copy of each submittal must be received by the Test and Balance Agency before work is begun.

- D. If complete submittals are not received by the A/E within the specified times, the A/E reserves the right to select the Test and Balance Agency with any additional costs incurred by the Contractor.

3.2 REPORT SUBMITTALS:

- A. Provide a preliminary typed report for engineers' review.
- B. After receiving engineers' review comments and address issues, submit three copies of the Test and Balance report. Report shall have systems, subsystems, and individual readings in a sequential format.
- C. Reports shall be submitted after all modifications required by these specifications to balance system have been made. Reports will not be accepted with comments such as damper missing, new drive required, etc.

3.3 DRAWING SUBMITTALS:

- A. Test and Balance Agency shall submit plans indicating:
 - 1. All traverse locations referencing values shown in reports.

3.4 COORDINATION OF WORK:

- A. Test and Balance Agency shall not begin work on a system until system is started as required in SYSTEM START-UP specifications.

3.5 CONTRACTOR REVIEWS AND INSPECTIONS:

- A. The Test and Balance Agency shall perform one pre-construction plan check and submit comments to A/E.

3.6 ENGINEER REVIEW:

- A. The A/E shall, at their discretion, recheck any or all of the test and balance work within 120 days of receipt of report. The Test and Balance Agency shall provide ample number of technicians and test equipment to perform the tests required.
- B. Upon completion of the A/E's recheck, the testing and balancing report, or portions thereof, shall be accepted or rejected. All parts not accepted shall be retested and rebalanced.
- C. Systems shall be tested, rebalanced and rechecked until accepted by all parties.

3.7 EXISTING SYSTEMS:

- A. Pre-demolition test report shall be submitted before demolition begins.
- B. Balance systems as directed by A/E after renovation work is completed and provide renovation test report.

3.8 MOTOR CAPACITY:

- A. At no time shall the motor exceed full load amps. Motor shall load into service factor only if written permission is received from the engineer.

END OF SECTION 23 0593

SECTION 23 0700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of insulation required for thermal and acoustical installation on all mechanical equipment, piping, ductwork, and appurtenances where shown on the drawings and specified hereinafter under applicable sections of this specification.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0713 - Duct Insulation
 2. Section 23 0719 - HVAC Piping Insulation

1.3 QUALITY ASSURANCE:

A. Flame and Smoke Spread Ratings:

1. All insulation materials must have a maximum 25/50 flame/smoke rating as tested by ASTM E-84, NFPA 255, and UL 723.
- B. Accessories such as adhesives, mastics, cements, and tapes for fittings shall have the same component rating as listed above.
 - C. All products or their shipping cartons shall bear a label indicating that flame and smoke ratings do not exceed requirements. Treatment of jackets or facing to impart flame and smoke safety shall be permanent. The use of water soluble treatments is prohibited.
 - D. Installation and materials shall meet the requirements of the International Building Codes.
 - E. All insulation work shall be applied by mechanics normally employed in the trade. All insulation shall be installed in accordance with the manufacturer's recommendations.

- F. All insulation furnished under this Division of the specifications shall be the product of one manufacturer except for special applications.
- G. Manufacturers:
1. The following manufacturers of sealants, adhesives, and mastics shall be:
 - a. Foster
 - b. Childers
 - c. Mon-Eco

PART 2 – PRODUCTS

2.1 MASTICS, SEALANTS, AND ADHESIVES:

- A. General:
1. Materials shall be as recommended by the insulation manufacturer.
 2. Products shall be applied as recommended by the manufacturer for that specific application.
 3. The number of coats and thicknesses shall meet or exceed the manufacturer's recommendation or as indicated in these specifications or on the plans, whichever is greatest (coats and thickness).
 4. Materials shall meet LEED requirements for low emitting products.

PART 3 - EXECUTION

3.1 GENERAL:

- A. All insulation materials shall be delivered and stored in manufacturer's container and kept free from dirt, water, chemical and mechanical damage.
- B. Insulation shall be applied by experienced workmen in a workmanlike manner.
- C. Insulation shall not be applied until all pressure testing has been completed, inspected and released for insulation application.
- D. Surfaces to be insulated shall be clean and dry.
- E. All insulation joints shall be butted firmly together and all jackets and tapes shall be smoothly and securely installed.

3.2 INSTALLATION:

A. General:

1. Insulation on cold surfaces where vapor barrier jackets are used shall be applied with a continuous, unbroken vapor seal.

END OF SECTION 23 0700

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SECTION 23 0713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of insulation required for thermal and acoustical installation on all sheet metal duct and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0700 - HVAC Insulation

1.3 QUALITY ASSURANCE:

A. Manufacturers:

1. The following elastomeric duct insulation manufacturers are acceptable:
 - a. Armacell
 - b. K-Flex
 - c. Aeroflex
 - d. Nomaco

PART 2 - PRODUCTS

2.1 ELASTOMERIC INSULATION:

A. Elastomeric Duct Insulation:

1. Insulation is a flexible elastomeric thermal insulation.

2. Insulation shall be .27 K value @ 75 degrees F, water vapor transmission of less than 0.08, water absorption of less than 0.2% (by volume) and shall not support microbial growth.
3. Basis of design insulation shall be:
 - a. K-Flex LS sheet

2.2 APPLICATION OF ELASTOMERIC INSULATION:

A. Outdoor duct:

1. Provide elastomeric insulation on the following systems:
 - a. Single wall supply duct
 - b. Single wall return duct
2. Two 1" layers are required.

2.3 STAINLESS STEEL JACKETING:

A. General:

1. Provide a complete system of stainless steel jacketing for the following duct systems:
 - a. Single wall supply duct
 - b. Single wall return duct
2. Jacketing shall be Type 304L stainless steel with a standard 2B mill finish. Jacket thickness shall be .024" minimum.
3. Jacketing shall be provided on all sides of the duct.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELASTOMERIC INSULATION:

- A. Insulation shall be adhered to the sheet metal with 100% coverage of adhesive.
- B. Provide 4" wide tape to match finish of elastomeric insulation.

3.2 STAINLESS STEEL JACKET INSTALLATION:

- A. All cuts shall be straight, perpendicular or parallel, and overlap adjacent jacket by a minimum of 4". Jacket shall be riveted or screwed with stainless steel fasteners 6" OC minimum and 1" from each edge or change of direction.
- B. Provide silicone caulk beneath each jacket overlap.
- C. Minimize jacket joints on top of duct.

END OF SECTION 23 0713

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SECTION 23 0719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of insulation required for thermal insulation on all piping where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0700 - HVAC Insulation

1.3 QUALITY ASSURANCE:

A. Manufacturers:

1. The following elastomeric pipe insulation manufacturers are acceptable:
 - a. Armacell
 - b. K-Flex
 - c. Aeroflex
 - d. Nomaco
2. The following pipe insert (for elastomeric pipe insulation) manufacturers are acceptable:
 - a. Aeroflex
 - b. Armafix
 - c. Armacell

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Pipe insulation shall comply with the International Energy Conservation Code or these specifications, whichever is greater.

2.2 TYPES OF INSULATION:

A. Elastomeric Insulation:

1. General:

- a. The insulation shall have a factory applied adhesive closure system.

2. Physical properties:

- a. Thermal conductivity (k) is .27 at 75 degrees F.
- b. Water transmission is .08 perms – inch.
- c. Will not significantly contribute to fire.

3. Basis of design insulation shall be:

- a. Armacell type AP Armaflex or type AP/SS

2.3 PIPE INSULATION APPLICATION:

A. General:

- 1. All fittings, valves, and accessories in the piping system shall be insulated similar to the piping system.

2.4 FINISH (OUTDOOR SOFT DRAWN REFRIGERANT PIPING):

- A. Outdoor refrigerant piping shall be wrapped with a prefabricated, self-adhering protective membrane.

- B. The outer layer shall be UV resistant.

- C. The inner layers shall be high density cross linked polymer film with a layer of asphalt adhesive.

- D. The basis of design wrap shall be

- 1. MFM FlexClad-400 or equal

2.5 PIPE INSERT (FOR ELASTOMERIC INSULATION):

A. General:

1. Insert shall be a closed cell, high compressive strength, foam insulating pipe support.
2. The insert shall be lined with a closed cell EPDM foam rubber and encased in a zero perm weatherproof membrane.

B. Properties:

| | |
|---------------------------------|----------|
| Compressive Strength (at yield) | 314 PSI |
| Thermal Conductivity | .312K |
| Water Absorption (by weight) | <7% |
| Water Vapor Permeability | 0.0 Perm |

C. Insert shall be sized for the pipe on which it is installed and the thickness of the adjacent insulation.

D. Basis of design manufacturer shall be:

1. Aerofix-U

PART 3 - INSULATION THICKNESS SCHEDULES

3.1 ELASTOMERIC INSULATION SCHEDULE:

A. Refrigerant Suction Lines, Hot Gas Reheat Lines, and Liquid Lines:

1. All pipe - 1" thk.

B. Indoor Drain Line:

1. All pipe – 3/4"

PART 4 - EXECUTION

4.1 INSTALLATION:

A. Apply adhesives, sealants, coatings, and other materials as recommended by the manufacturer.

B. All penetrations through vapor barrier shall be sealed with vapor barrier sealer. Where metallic jacketing is used, all penetrations through jacket and at termination of jacket shall be sealed.

- C. Butt joints and seams of elastomeric insulation shall be sealed with contact adhesive as recommended by the insulation manufacturer. Where possible, insulation shall be used without slitting and slipped over tubing. All fittings shall be covered and sealed with fabricated pieces of the same insulation and adhesive.

4.2 ANCHORS AND SUPPORTS:

- A. Anchors and supports that are secured directly to cold surfaces shall be adequately insulated and vapor sealed to prevent condensation.
- B. Jacketing shall be carried through hanger on inside of 16 gauge sheet metal shields and sealed to maintain continuous vapor barrier.

4.3 ELASTOMERIC INSULATION:

- A. Inserts:
 - 1. Center insert on hanger or pipe support.
 - 2. Insert shall be installed using the insert manufacturer's adhesive to seal the insert to the adjacent pipe insulation.
 - 3. The insert and adjacent insulation shall be wrapped with the insert manufacturer's tape to seal and finish the installation. The tape shall wrap the insulation/insert two complete times.
- B. Tape:
 - 1. 3/4" longitudinal tape specifically listed for use on elastomeric insulation shall be installed along every longitudinal seam/joint.

END OF SECTION 23 0719

SECTION 23 0900 - INSTRUMENTATION AND CONTROLS FOR HVAC (GENERAL)

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of the building environmental controls shown on the drawings and specified hereinafter.

B. Description:

1. Control and instrumentation work shall include:
 - a. Temperature control
 - b. Humidity control
 - c. Equipment interlock and controls
 - d. Wiring for automatic controls

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0904 - Building Automation System
 2. Section 23 0905 - Smoke Devices and Systems

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. All environmental controls shall comply with all local codes and ordinances, and meet or exceed the following standards:
 - a. Underwriters Laboratories
 - b. NEMA Standards

- c. National Electric Code
 - d. Scientific Apparatus Makers Associates Standard PMC 20.1 for Process Measurement and Control Terminology
 - e. Scientific Apparatus Makers Associates Standard PMC 20.2 for Process Control Performance
 - f. NFPA 90A
 - g. NFPA 72E Standard for Automatic Fire Detector
- B. Control circuit wiring shall meet NFPA Standard 70, Article 725, for remote control, low energy power, low voltage power and signal circuits.
- C. All control equipment shall be the product of one manufacturer whenever practical.
- D. Manufacturers:
- 1. The following Building Environmental Controls Contractors are acceptable:
 - a. Control Management, Columbia, South Carolina
 - 2. The following control manufacturers are acceptable:
 - a. Seimens
 - 3. The following needlepoint bipolar ionization manufacturers are acceptable:
 - a. GPS
 - b. Approved equal

PART 2 - PRODUCTS

2.1 GENERAL:

- A. The building environmental controls shall be provided by the Building Environmental Controls Contractor.
- B. The Building Environmental Controls system shall be installed by competent controls mechanics who are full time employees of the Building Environmental Controls Contractor.
- C. The Environmental Control Contractor shall be responsible for the quality and satisfactory operation of the devices within the system and for the overall performance of the specified air flow control system.

2.2 SYSTEM:

- A. Provide all thermostats, humidistats, sensors, transmitters, controllers, actuators, control panels, conduit, wiring, accessories and appurtenances for a complete building environmental control system.
- B. Provide switches, fuses, disconnects and all other devices necessary for protection and convenient operation of system.
- C. The contractor shall be responsible for providing power wiring, conduit, breakers and final connections for all control devices, panels, and components unless specifically shown on electrical plans:
 - 1. Control devices
 - 2. Motorized dampers
- D. The control system shall be on normal power.

2.3 CONDUIT:

- A. General:
 - 1. All control conduit shall be furnished and installed under this division except where specifically indicated otherwise.
 - 2. All control wiring in existing construction shall be run in conduit.
 - 3. Conduit shall be provided in accordance with the Electrical Division of this specification unless noted otherwise in these specifications.
 - 4. Outdoor conduit shall be GRC.
 - 5. Indoor conduit shall be EMT.
 - 6. Conduit shall be 3/4".

2.4 CONTROLS WIRING:

- A. Wiring for low voltage circuits generally shall be No. 18B and S gauge or larger RSH-2 heat resistant.
- B. Cables of two or more conductors, not smaller than 22 B and S gauge if shielded or No. 18 B and S gauge if not shielded, may be used for low voltage d-c and electronic circuits carrying less than 1.50 amperes, in lieu of individual wires.
- C. Cables carrying a-c circuits sensitive to external fields shall be shielded.
- D. Cables having fewer than 12 conductors shall have thermoplastic or rubber insulation for 300 volts or more and a heavy outer braid or thermoplastic sheath. Shields shall be

grounded to building's grounding system, using wire not smaller than No. 14 B and S gage. Shields shall not be grounded to conduit systems or building piping.

- E. Cables shall terminate in solder or screw type terminal strips. All terminal strips shall be numbered.
- F. Cables shall not be tapped at intermediate points.
- G. All wires, whether individual or in cables, shall be color coded and numbered for identification in accordance with the National Electric Code.
- H. Wire, where specifically permitted to be installed without conduit, shall be plenum rated.

2.5 TRANSFORMERS:

- A. Transformers shall be furnished and installed for supplying current to control equipment as required.
- B. Transformers shall conform to NEMA standards, shall be capable of supplying 125 percent the connected load, shall be enclosed in U.L. listed cabinets, ventilated, with conduit connections, and provided with fused disconnect switches on primary side and on secondary side.

2.6 CONTROL VOLTAGE:

- A. Voltage shall not exceed 24V.

2.7 SPACE SENSOR:

- A. Provide sensor to monitor space temperature, humidity, and CO₂.
- B. Sensor shall be Seimens QMX3.P74.
- C. Provide metal guard.

2.8 SAFETY DEVICES:

- A. General:
 - 1. Safety devices including, but not limited to, the following shall be hard wired to perform their required function. Status, where specified, shall be monitored by the building automation controls system and initiate other sequences where required:
 - a. Condensate overflow switch

2.9 CONTROL PANELS:**A. General:**

1. All controllers, relays, switches, etc., for equipment shall be mounted in enclosed control panels with key lockable, piano hinged door.
2. Location of each panel shall be where indicated on plans, approved by A/E, and convenient for adjustment and service.
3. Label each panel properly identifying function or service of panel and all surface mounted devices.
4. Control panels shall be extruded or formed, cold-rolled steel, enamel surfaced, with full length mounting brackets, drilled wall mounting holes.
5. The control panel shall be key lockable.
6. Provide a 24V control transformer.

2.10 FLOAT SWITCH:**A. General:**

1. Float switch shall include a sealed, waterproof reed/magnet float switch with no exposed electrical contacts.
2. Float shall be prewired with 6 ft. long, 18 ga. lead cables.
3. Switch shall be tested to UL 508 and UL listed for 24V AC.
4. Float shall attach to drain pan with stainless steel clips.

B. Locations:

1. All drain pans.

C. Basis of design manufacturers shall be:

1. SMD Research Safe-T-Switch Model SS3.

2.11 EQUIPMENT STATUS:

- A. Equipment status shall be provided by solid state current sensors.
- B. Sensor shall have non-polarity sensitive outputs, trip point adjustment, trip LED, and power LED.

2.12 THREE PHASE VOLTAGE MONITOR:

- A. Monitor shall be autoranging type that detects single phasing, low voltage, phase reversal or voltage unbalance. When a harmful condition exists, the output relay shall deactivate. When the harmful condition is removed, the relay shall reactivate.
- B. The three phase voltage monitor shall be field or factory installed on all three phase equipment.
- C. If three phase protection is already provided with the equipment via the VFD or other means, the control contractor does not have to provide additional three phase protection.

2.13 BIPOLAR IONIZATION:

- A. General:
 - 1. The electrodes shall be needlepoint type. Needlepoints shall not protrude into the airstream.
 - 2. The bipolar ionization system shall be capable of:
 - a. Effectively killing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).
 - b. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
 - c. Reducing space static charges.
 - d. Reducing space particle counts.
 - 3. The bipolar ionization system shall produce equal amounts of positive and negative ions.
 - 4. Relative humidity from 0 – 100%, condensing, shall not cause damage, deterioration, or dangerous conditions to the air purification system.
 - 5. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 2998.
 - 6. The operation of the electrodes or bipolar ionization units shall conform to UL 2998 with respect to ozone generation.
- B. Electrodes:
 - 1. Each plasma generator shall include the required number of electrodes and power generators sized to the air handling equipment capacity.
 - 2. Ionization output from each electrode shall be a minimum of 5 million ions/cc when tested at 2" from the ion generator.

C. Air Handler Mounted Units:

1. The entire cooling coil shall have equal and adequate ionization distribution across the face of the coil.
2. Ion generators shall be mounted in a linear configuration to minimize space required. The ion generators and mounting bar shall be 4" deep or less.
3. The power supply shall accept the following voltages: 12V DC; 24V AC; 120V AC; or 230V AC. Power from the power supply to the ionization generators shall be 12V DC.

D. Electrical:

1. Generators shall include internal short circuit protection, overload protection, and automatic fault reset.
2. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
3. The power supply shall have an On/Off switch and power indicator LED.

E. Control:

1. Generators shall include an external control interface to monitor generator status and alarm.

F. Control (Air Handler Mounted Units):

1. The system shall be provided with a standalone ion sensor to monitor ion output.
2. The ion sensor shall measure real time density of ions/CM³.
3. Sensors shall be designed to be mounted anywhere in the system downstream of the ion generator.
4. Sensor shall include an external control interface to monitor proper ion generation.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General:

1. The Building Environmental Controls Contractor shall be responsible for a complete operational system.

2. The installation shall include:
 - a. Drawings
 - b. Supervision
 - c. Interlocks
 - d. Adjustments
 - e. Verification
 3. Location of sensing elements shall be the responsibility of the installer.
- B. Wiring splices shall not be permitted in electrical panelboards, junction boxes and switchgear.
- 3.2 SPACE SENSORS:
- A. General:
1. Install all devices as recommended by manufacturer.
 2. The control contractor shall be responsible for coordination with the equipment supplier to ensure compatibility of components to meet the requirements of the equipment manufacturer and the control sequence.
- B. Installation:
1. Mount sensors 4'-0" above finished floor to the top of the device's control mechanism unless noted otherwise.
 2. Install metal guard.
- 3.3 CONDUIT:
- A. Conduit sleeves thru non-waterproofed walls and floors shall be grouted and caulked on both sides of wall.
- 3.4 EXISTING CONSTRUCTION:
- A. Conduit and wiring shall be installed above existing ceilings. The Contractor shall be responsible for removal of all other existing tile/grid and replacement of the tile/grid as necessary. Any damaged tile/grid shall be replaced by the Contractor at the Contractor's expense.

3.5 DEVICES ON EXTERNALLY INSULATED DUCTS:

- A. Devices mounted on externally insulated ducts shall be mounted on standoff brackets to allow proper installation of duct. If device must be mounted directly to duct for proper operation, standoff bracket may be deleted.

3.6 FLOAT SWITCH:

- A. Secure bracket to drain pan with screw.
- B. Verify float is properly positioned.

3.7 BIPOLAR IONIZATION:

- A. Submittals:
 - 1. Air handler bipolar ionization generator submittals shall include dimensional drawings showing the units in which the generators are to be installed. The submittal shall include documentation stating that the installation requirements have been coordinated with the air handler manufacturer.
- B. Installation (Air Handler Bipolar Ionization Generators):
 - 1. Air handler bipolar ionization generators shall be factory or field installed. If field installed, installation shall be in strict accordance with manufacturer's written recommendations.
 - 2. The ionization generators shall be wired to the remote mounted power supply.
 - 3. Install ion sensor in duct system where accessible for servicing.

END OF SECTION 23 0900

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SECTION 23 0904 - BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of the building automation system shown on the drawings and specified hereinafter.

B. Description:

1. The work shall include, but not be limited to, the following:
 - a. Field programmable digital system controller(s).
 - b. Digital transmission system.
 - c. Field programming to perform monitoring and control functions specified herein and on point schedule.
2. All sensors, actuators, transducers, solenoids, transformers, wiring and appurtenances shall be provided for a complete building automation system.
3. Digital controller shall include the distributed microprocessors.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0900 - Instrumentation and Control for HVAC (General)

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. All equipment and components shall comply with all local codes and ordinances, and meet or exceed the following standards:
 - a. American Society for Testing and Materials ASTM

- b. Institute of Electrical and Electronic Engineers IEEE
 - c. National Electrical Manufacturers Association NEMA
 - d. Underwriters Laboratory, UL (UL 916)
 - e. FCC Regulation, Part 15, Section 156
 - f. National Fire Protection Association NFPA
- B. All the equipment shall have the UL label.
- C. Manufacturers shall be:
1. Siemens

PART 2 - PRODUCTS

2.1 GENERAL:

- A. The control system shall consist of high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Operators shall be able to perform all normal operator functions through the web browser interface including downloading memory, parameters, and schedules to any module. The system shall be capable of interfacing with Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA).
- B. The system shall support Wb services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher.
- C. The system shall be capable of future expansion to include monitoring of occupant card access, fire alarm, lighting control systems, cameras and security systems.
- D. The control algorithm shall be proportional and integral. Derivative functions are required where stability of the controller is not likely with PI algorithms.
- E. A control panel used to control equipment on a floor shall typically not be used to control equipment on any other floor (i.e. Panel for terminal units for first floor terminal units shall not be used to control second floor terminal units).

2.2 BacNet COMMUNICATION PROTOCOL:

- A. The system shall use the BacNet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms shall be BacNet objects and shall conform to ANSI/ASHRAE Standard 135-2004, BacNet.

2.3 DIGITAL CONTROLLER COMPONENTS:

A. General:

1. Each controller shall consist of the following:
 - a. Enclosure with keyed hinged door and mounting brackets
 - b. Power assembly
 - c. System microprocessors
 - d. Communications board
 - e. Field termination board

B. Power Assembly:

1. The power assembly shall consist of :
 - a. Transformer
 - b. Filter to eliminate transients
 - c. Power regulator/surge suppresser
 - d. Battery charging circuit
 - e. Battery with 24 hour backup for RAM

C. Display:

1. The digital display shall be programmed to display analog variables, binary conditions, off normal scans and other analog and binary information required for analysis and adjustment of the system being controlled.

2.4 COMMUNICATIONS:

A. General:

1. All digital devices shall be assigned a numeric address.
2. Communications, commands and responses shall be digital.
3. Communications hardware shall include all encryption, filtering, amplifications diagnostics and error lodging.
4. Provide surge suppresser.

2.5 DIGITAL CONTROLLER CAPABILITIES:

A. Field Programmable:

1. The controller shall contain all necessary mathematics, logic, utility functions and all standard energy calculations and control functions in ROM to be available in any combination for field programming the unit. These routines shall include but not be limited to:

- a. Math routines:

- 1) Basic arithmetic
- 2) Binary logic
- 3) Relational logic
- 4) Fixed formulas for psychrometric calculations

- b. Utility routines for:

- 1) Process entry and exit
- 2) Keyboard functions
- 3) Variable adjustments and output
- 4) Alarm indication

- c. Control routines for:

- 1) Signal compensation
- 2) Loop control
- 3) Energy conservation
- 4) Timed programming

2. Final field programs shall be stored in battery backed up RAM.

B. Calibration Compensation:

1. The digital controller shall sense the voltage being supplied to the resistance sensing element and through firmware and shall compensate for power supply changes due to ambient temperature changes at the power supply.

C. Diagnostics:

1. The digital controller shall continuously perform self diagnostics. All malfunction shall alarm the front end system.

- D. Default Operating Procedure and Alarms:
1. All variables shall be identified as being reliable or unreliable. When a calculation is required to use a value (sensed or calculated), which is identified as being unreliable, the unreliable data value will flash. The calculation will use a default value programmed into the unit.
 2. All alarms shall be indicated at the digital controller and at the front end system.
- E. Energy Management Functions:
1. The controller shall be capable of performing the following energy management functions:
 - a. Time of day scheduling
 - b. Start/Stop optimization
 - c. Peak demand limiting
 - d. Occupied/Unoccupied mode
- F. User Specified Programs:
1. The controller shall be capable of generating programs specified by the user including:
 - a. Intermediate season control (dead zone)
 - b. Trending of variables
 - c. Historical data storage
 - d. Totalizing
 - e. Holiday and event programming
- G. Control Loop Compensation:
1. Control loop compensation shall include:
 - a. Hysteresis correction
 - b. Limited control output
 - c. Ramp output
 - d. Anti-reset windup

H. Access Levels:

1. The controller shall have a minimum of three levels of passwords as follows:
 - a. Level One - Read all setpoints
 - b. Level two - Program occupied periods
 - c. Level Three - Program all setpoints and programs

2.6 GRAPHICS:

- A. Graphics shall operate thru the microprocessor and shall be dynamic and animated.
- B. The graphic software shall display and update current control point data.
- C. Notification of alarms from the panels must be provided on the graphic display while the system is in graphics mode.
- D. A library of HVAC symbols shall be provided for use in generating custom displays.
- E. The graphic display shall indicate alarm conditions for each air handling unit.

2.7 SURGE PROTECTION:

- A. Surge suppression shall be provided on communications lines and power sources at each control panel.
- B. Surge suppression shall be type recommended by manufacturer to provide maximum protection of system components.

2.8 OWNERS WITH EXISTING BUILDING AUTOMATION SYSTEMS:

- A. When this facility is brought on-line, the existing software and hardware shall be upgraded as necessary to support the graphics, sequences and other functions of the building automation system.
- B. The data, information and graphical representations of the systems at this facility shall be equal to or greater than that installed for other facilities in the District or as indicated in these specifications, whichever is greater.

2.9 SETPOINT CHANGES:

- A. Setpoints shall be changed on function blocks. User must also be able to change setpoints without having to go to the function blocks. Acceptable methods include changing setpoints on a "Properties Page" or on the system graphics.

PART 3 - EXECUTION

3.1 OPERATION:

- A. Upon restoration of power, equipment shall be sequentially started and shall at no time exceed last demand limit setting.

END OF SECTION 23 0904

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SECTION 23 0993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS AND POINTS LIST

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of controls system shown on the drawings and specified hereinafter.

B. Description:

1. Points shown for equipment shall be for each item of equipment except:
 - a. When noted otherwise.
 - b. When exhaust fans are grouped together.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:

1. Section 23 0900 - Instrumentation and Control for HVAC (General)
2. Section 23 0993.6 - Sequence of Operation (Single Zone Packaged Equipment)

PART 2 - SEQUENCE OF OPERATION

2.1 GENERAL:

- A. These sequence descriptions and definitions shall apply to all sequences unless sequence specifically indicates otherwise.

2.2 SETPOINTS:

- A. In general, the specification indicates setpoints or range of setpoints for most devices.
- B. Temperatures shall be field settable to any temperature.

- C. Time of day operations shall be field settable to any time.
- D. Time delays shall generally be field settable as follows:
 - 1. 0-60 second delay: settable from 0-300 seconds.
 - 2. 0-5 minute delay: settable from 0-60 minutes.
- E. The contractor shall adjust setpoints in the following manner:
 - 1. As required to start-up, test, debug and otherwise ensure equipment and system is operating as intended.
 - 2. Dampers, actuators, and similar devices should be left in their optimum operating position.
 - 3. Thermostats, humidistats, and similar devices should be left as indicated on drawings or in specifications. If no value is indicated, contractor should set at a reasonable value.
 - 4. Equipment and system schedules should be reviewed with the Owner and A/E prior to initiating the schedule.

2.3 MORNING WARM-UP/COOL-DOWN:

- A. This mode is the mode between night setback and normally occupied mode and is used to bring area served from unoccupied conditions to conditions required for occupancy.
- B. This mode typically will operate with outside air systems closed or de-energized.
- C. The start time of this mode shall be determined by the building automation system based upon space temperatures, building characteristics, outside temperature, and historical ability of each system to warm up or cool down the building.

2.4 NIGHT SETBACK:

- A. This mode is the unoccupied mode.
- B. This mode is a timed function of adjustable duration.
- C. This mode typically will operate with outside air systems closed or de-energized and is used primarily to maintain unoccupied space temperature (adjustable) or space humidity level (adjustable).
- D. All HVAC equipment required to maintain space conditions shall be energized in this mode.

2.5 OVERRIDE:

- A. When override is activated, the system shall operate with that zone, equipment, or system in the occupied mode.
- B. At the end of the override time period, the zone equipment or system shall return to the mode scheduled at that time.

2.6 OUTSIDE AIR CONTROL:

- A. Where motorized dampers are specified, the dampers shall open to maintain the airflow quantity indicated on the equipment schedule.

2.7 FAILURE MODES:

- A. General:
 - 1. Initiating devices shall each be hard wired.
 - 2. Manual reset of temperature alarm and pressure alarm shall be required. Other alarms shall automatically reset unless manual reset indicated.
- B. High Condensate Level:
 - 1. Upon a rise in condensate level in the condensate pan, the float switch shall de-energize the unit.

2.8 SYSTEM OPTIMUM START:

- A. The building automation control system shall provide an optimum start sequence for the HVAC system.
- B. Optimization shall be determined by a comparison of indoor and outdoor environmental conditions and system capacities.
- C. At the completion of optimum start, the building shall be at design temperatures. This is not necessarily, and in most cases will not be, the same time as the start of the occupied period. For example, the completion of optimum start could be set at 7 am and the occupied mode set at 9 am. The occupied mode is typically when ventilation air would be energized.

2.9 ALARMS:

- A. In addition to the alarms indicated, all temperatures and other monitored or sensed conditions that fall above or below the normal range shall be alarmed.

- B. Alarms shall be assigned a level of alarm (minimum three levels - low (maintenance), high (important), and critical).

2.10 REMOTE NOTIFICATION:

- A. Critical alarms shall be sent via text and/or email to up to six (6) Owner identified recipients.

PART 3 - POINT SCHEDULE

3.1 DEFINITION OF POINTS:

A. Binary Output:

- | | | |
|----|---------------|----------------------------|
| 1. | Control Relay | - Energize/de-energize |
| 2. | Solenoid | - Steam Valve Gas Valve |
| 3. | Hand/Off/Auto | - Starter |

B. Analog Output:

- | | | |
|----|-----------------|--|
| 1. | Cooling | - Control Valve |
| 2. | Heating | - Control Valve SCR Heater |
| 3. | Humidification | - Control Valve |
| 4. | Economizer | - Dampers |
| 5. | Position Adjust | - Fan Drives Pump Drives Dampers VAV Damper |

C. Binary Input:

- | | | |
|----|-----------------------|---------------------------------|
| 1. | Differential Pressure | - Fan Status Pump Status |
| 2. | Pressure Switch | - Pressure |
| 3. | Flow Switch | - Fan Status Pump Status |
| 4. | Fire/Smoke | - Smoke Detector Fire Sensor |

- 5. Freeze - Low Limit
- 6. Filter - Filter Pressure
- 7. Setback Override - Night Setback Override

D. Analog Input:

- 1. Humidity - Humidity
- 2. Temperature - Temperature
- 3. Static Pressure - Static Pressure
- 4. Fan Speed/Load - Fan Drives
- 5. Air Flow - Air Flow

END OF SECTION 23 0993

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SECTION 23 0993.6 - SEQUENCE OF OPERATION (SINGLE ZONE PACKAGED EQUIPMENT)

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of controls system shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0993 - Sequence of Operations for HVAC Controls and Points List

PART 2 - SEQUENCE OF OPERATION

2.1 GENERAL:

A. Unit Operation:

1. The indoor fan, exhaust fan, compressors, heating coil, reheat coil, and outside air damper shall be controlled independently of each other by the direct digital controller.
2. Cooling and heating shall not operate simultaneously except where specifically specified otherwise.
3. Electric heat shall be disabled until air flow switch proves proper air flow.
4. When system is in occupied or override modes, the system shall operate in occupied mode.

B. Heating Control (Heat Pump):

1. Upon a demand for heating, the reverse cycle unit shall load compressor.
2. If additional heat is required or the compressor fails to energize, the auxiliary heat shall be energized.

3. Electric heat shall be energized during the defrost cycle.
4. Electric heat shall stage or proportionally energize to maintain sensor setpoint.

C. Cooling Control:

1. Upon a demand for cooling, the unit cooling sequence shall energize.
2. The compressors shall load to maintain sensor setpoint.

D. Indoor Fan Operation:

1. The fan shall run continuously when the unit is energized except where noted otherwise.

E. Morning Warm-Up:

1. Unit shall operate in heating to bring space to design temperature.

F. Outside Air Damper:

1. The outside air damper shall be closed during unoccupied mode.
2. The outside air damper shall be closed during morning warm-up mode.
3. The outside air damper shall be open during occupied mode.

G. Unoccupied Mode:

1. When space temperatures drop below the night low limit setpoint, the unit shall energize in heating.
2. When space temperatures rise above the night high limit setpoint, the unit shall energize in heating.
3. When the space humidity rises above setpoint, the system shall operate in dehumidification mode.

H. Failure Mode:

1. High condensate level
2. Others indicated with equipment or required by manufacturer.

2.2 PACKAGED COOLING AND HEATING UNITS (WITH HOT GAS REHEAT):

A. Unit Operation:

1. The units shall be controlled by a space thermostat, space humidistat, and direct digital controller.

B. Dehumidification Mode:

1. The unit shall operate in cooling mode when humidity level exceeds setpoint.
2. The hot gas reheat valve shall modulate to maintain the space temperature setpoint.

END OF SECTION 23 0993.6

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SECTION 23 2113 - HVAC PIPING (GENERAL)

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of pipe, pipe fittings, accessories and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0529 - Hangers and Supports for HVAC Piping

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. All pipe and pipe fittings shall comply with American National Standards Institute Code, all local codes and ordinances, and meet or exceed the standards and procedures (latest editions) of the following:
 - a. Non-Ferrous Metallic Pipe and Fittings:
 - 1) Copper Tube, Water, Seamless, Types K, L, and M. ASTM B88
 - 2) Pipe Fittings, Brass or Bronze, 125 and 250 lbs., Cast or Wrought. ANSI B16.15
 - 3) Solder Joint Fittings, Pressure, Copper Alloy. ANSI B16.22
 - 4) Refrigerant Piping. ANSI B31.5, ANSI B36.40, ASTM A333
 - 5) Copper tube (drain, vent) DWV. ASTM B306
 - 6) Copper tube (refrigeration), ACR. ASTM B280
 - b. Pipe Joining Materials, Gaskets, Methods, and Accessories:
 - 1) Soldering and brazing ANSI B9.1

- B. Material shall be new domestic materials (made in the USA) of standard manufacture suitable for specified use.
- C. Manufacturer shall certify materials conform to reference specifications, or specification number shall be cast into or marked on each piece.
- D. Manufacturers:
 - 1. The following solder manufacturers are acceptable:
 - a. United Wire
 - b. Engelhard
 - c. Elkhart

PART 2 - PRODUCTS

2.1 GENERAL:

- A. No materials shall be co-mingled within the same system except those which are specifically approved in these specifications.

2.2 PIPE SCHEDULE:

- A. Cooling Coil Condensate Drain Piping:
 - 1. Indoor piping shall be seamless hard drawn, Type L, copper pipe.
 - 2. Outdoor piping shall be seamless hard drawn, Type L, copper pipe.
- B. Refrigerant Piping:
 - 1. Piping shall be seamless hard drawn, Type L, ACR, copper pipe.
 - 2. Piping shall be dehydrated, charged with nitrogen, and capped.

2.3 FITTINGS AND CONNECTIONS:

- A. Fittings shall be the same material and weight as the pipes joined by the fitting unless noted otherwise. Fittings shall comply with all applicable standards.
- B. Copper Pipe Fittings - Water Service:
 - 1. Fittings shall be wrought copper.
 - 2. Solder used for fittings shall be zero percent lead, 200 PSI working pressure, installed as recommended by the manufacturer and applied to clean surfaces.

Connections to valves and other types of piping shall be made with brass, copper or bronze adapters, sweat type to threaded type or cast copper companion flanges. Connections to valves and other dissimilar materials shall be made with dielectric unions where hereafter specified.

3. Fittings in non-concealed locations:

a. Fittings shall be soldered unless noted otherwise.

b. Solder shall be:

1) United Wire SIL-PH0S

2) Engelhard Silvabrite 100

C. Copper Pipe Fittings - Refrigerant Service:

1. Fittings shall be wrought copper.

2. All joints shall be brazed.

3. Brazing material may be an alloy of silver, copper and/or phosphorus with a minimum melting point above 1100 degrees F.

PART 3 - EXECUTION

3.1 GENERAL:

A. Pipe shall be installed in strict accordance with manufacturer's recommendations.

B. Cut pipe accurately to measurements established at building or site, and work into place without springing or forcing.

C. Each length of pipe, as erected, shall be upended and rapped. Dirt and all foreign matter shall be cleaned from pipe and fittings before installation.

D. All turns and connections shall be made with long radius fittings as specified hereinafter.

E. Piping shall be installed straight and level except where required to be sloped.

3.2 REFRIGERANT PIPE:

A. Cut refrigerant pipe with wheel cutter only. Do not saw or ream.

3.3 PIPE INSPECTION:

A. The Owner and A/E reserve the right to inspect, sample, and test any pipe after delivery and to reject all pipe represented by any sample which fails to comply with the specified requirements. Inspection of pipe shall be for pits, blisters, rough spots, breakage, or other

imperfections. Any pipe which has been rejected because of the above shall be conspicuously identified and immediately removed from the construction site.

3.4 DRAINAGE PIPING:

- A. Provide cleanouts at all changes of direction totaling 90 degrees or more.

END OF SECTION 23 2113

SECTION 23 3112 - MECHANICAL DUCT

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of mechanical duct, accessories, and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 23 Specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 3113.01 - Metal Duct

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. Mechanical duct systems shall be fabricated and installed in accordance with the manufacturer's recommendations and meet or exceed the standards and procedures (latest editions) of the following:
 - a. SMACNA, Balancing and Adjustment of Air Distribution
 - b. SMACNA, Low Pressure Duct Construction Standards
 - c. SMACNA, Duct Cleanliness for New Construction Guidelines
 - d. SMACNA, HVAC Duct Construction Standards
 - e. NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems
 - f. ASHRAE Handbook of Fundamentals and ASHRAE Systems and Equipment Handbook
 - g. International Building Codes

2. Duct shall be Class 0 in accordance with UL Standard 181. Where permitted by Code, Class 1 duct shall be allowed.
 3. All duct system components including insulations, adhesives, mastics, cements, tapes, coverings, connectors and appurtenances shall have a maximum UL flame spread of 25 and a smoke development rating of 50 as tested by ASTM E-84.
 4. Duct sealants shall meet UL 181A and UL 181B.
- B. Manufacturers:
1. The following duct sealant manufacturers are acceptable:
 - a. AirSeal McGill
 - b. Ductmate
 - c. Hardcast

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Dimensions shown on the plan are finished inside dimensions.
- B. Ducts shall be smooth on inside.
- C. The general location of ducts shall be as shown on the contract drawings. Exact location of ductwork shall be determined by the Contractor.

2.2 SEALING DUCTS:

- A. General:
 1. Sealants shall be water based. Solvent based sealants are not acceptable.
 2. Sealants shall be UV, water and mildew resistant.
 3. Sealants shall be suitable for low, medium and high pressure applications up to 15" WG.
 4. Sealants shall have a mild odor, no flashpoint, and not require a respirator for application.
- B. Basis of design sealant (exposed to weather) shall be:
 1. McGill AirSeal Uni-Weather.

2.3 DUCT SHIPMENT:

A. Intermediate Level (SMACNA):

1. Ducts leaving the place of fabrication shall be kept clean and dry.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Contractor shall provide additional bends and offsets as may be required to bring ductwork into proper relation with other equipment and features of the building.
- B. Where changes are made in shape of ducts, full area shall be maintained and changes shall be gradual to minimize pressure drop.

3.2 DUCT STORAGE:

- A. Duct shall be protected by storing on elevated supports.
- B. All ducts shall have ends capped during storage.
- C. The area used for storage shall be kept dry and clean.

3.3 PROTECTION AND CLEANING DURING INSTALLATION:

- A. During construction, all open ends of duct installed shall be capped.
- B. Prior to capping, all interior duct surfaces shall be wiped clean.

3.4 COMPLETION AND DEMONSTRATION:

- A. Upon completion of the duct system installation, and before the A/E has inspected the system operation, open all system dampers and turn on fans to blow all scraps and other loose material out of the duct system. Allow for a means of removal of such material.
- B. Check the duct system to ensure there are no excessive air leaks. Where there are unacceptable leaks, the leakage shall be repaired and shall be done so in a manner of a new installed system. Excessive air leaks shall be leaks that exceed industry standards, cause higher than acceptable noise, or where leakage exceeds reasonable expectations.

END OF SECTION 23 3112

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SECTION 23 3113.1 - METAL DUCT

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of all metal duct where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 3112 - Mechanical Duct

1.3 QUALITY ASSURANCE:

- A. Codes and Standards: All work shall meet or exceed the standards and procedures (latest editions) of the following:
 1. Underwriter Laboratories, UL 103
 2. ANSI Z223.1
- B. Material shall be free from blisters or other mechanical defects. Material shall be galvanized prime sheet steel unless noted otherwise.
- C. Sheet metal thickness, cross joints, seams, slip-connections, cross-breaking, bracings, duct supports and reinforcing shall be in accordance with the more stringent requirements of ASHRAE Guide and SMACNA Duct Construction Manual for system pressure classifications. Minimum gauge thickness is 26 unless thicker gauges are indicated.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Closure:

1. Transverse joints and seams in sheet metal duct shall be of the types and sizes recommended by SMACNA and the ASHRAE Handbook for the specific duct pressure classification.

2.2 RECTANGULAR DUCT (DUAL WALL):

A. Duct:

1. Dual wall shall be:
 - a. Outdoor supply: 2"
 - b. Outdoor return: 2"

B. Materials:

1. Outer wall stainless steel (outdoor)
2. Inner wall galvanized

C. Liner:

1. Fittings shall have solid liner.
2. Dual wall duct shall have solid liner.

D. Insulation:

1. Insulation shall be .27K @ 75 degrees F.
2. Insulation shall be thickness of the dual wall.

E. Location:

1. Dual wall duct shall be provided in the following locations:
 - a. As indicated on plans.

PART 3 - EXECUTION

3.1 DUCT DRAWINGS:

- A. Provide 1/4" scale CADD drawings indicating layout of all duct.

- B. Where new duct ties into existing duct, existing duct must also be shown based upon field verified dimensions.

3.2 SUBMITTALS:

- A. Provide a list of all duct materials and systems in which they are to be installed for the entire project.

END OF SECTION 23 3113.1

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SECTION 23 4100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of air distribution equipment and appurtenances where shown on the drawing and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
 - a. AMCA 300 - Certified Ratings for Sound and Airflow
 - b. AMCA 210 - Test Code for Air Moving Devices
 - c. Insulation - NFPA 90A and UL 181
 - d. ASHRAE 52 Test Standard for filter efficiencies
 - e. UL Standard 900 for filter flame and smoke rating

B. Manufacturers:

1. The following filter manufacturers are acceptable:
 - a. Camfil Farr
 - b. American Air Filter
 - c. Airguard
 - d. Flanders Precisionaire

- e. Glasfloss
- f. Airflow, Inc.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Equipment with filters 4" or less in depth requires the following filters:
 - 1. First set shall be installed before initial start-up.
 - 2. Second set shall be installed for testing and balancing.
 - 3. Third set shall be turned over to the Owner at final inspection.

2.2 TWO INCH (2") PLEATED PANEL FILTERS:

- A. MERV 13 Filters:
 - 1. Panel filters shall be flat throwaway type constructed of high strength moisture resistant board forming a double wall around the filter media.
 - 2. A metal support grid is bonded to the leaving air side of the pleated media.
 - 3. The filters shall be UL Class 2 approved and listed.
 - 4. Filter shall have a maximum initial pressure drop of 0.41 inches WG at 500 FPM and 15 pleats per linear foot for 2 inch filters.
 - 5. Filter shall not have an electrostatically enhanced media.
 - 6. Filter media and frame shall be from 100% recyclable material.
 - 7. Basis of design filter shall be:
 - a. Camfil Farr AP-Thirteen

2.3 TEMPORARY FILTERS:

- A. During start-up, preliminary testing of system, operation of system prior to system being ready for testing and balancing, or operation of a system prior to final building cleaning, the contractor shall protect all equipment, coils, and the entire duct system with filters.
- B. Filters shall be MERV 8 minimum and contain an antimicrobial biocide to control the growth of mold, mildew, algae, and fungi on the filters (i.e., fibers shall not support microbial growth). Biocide shall not offgas, migrate, or leach into the airstream.

C. Basis of design filter shall be:

1. Fiberbond Dustlok

2.4 EQUIPMENT REQUIREMENTS:

A. Filters shall be provided on all equipment to protect heat transfer components from airstreams that would foul heat transfer surfaces.

B. Air handling equipment shall have a 2" pleated panel filter. The 2" filter shall be MERV 13.

PART 3 - EXECUTION

3.1 TEMPORARY FILTERS:

A. The contractor shall install temporary filter media on all negative pressure openings if the system is to be operated prior to the final cleaning of all spaces served by a system. These openings include open return ducts, exhaust ducts, and grilles. All filters shall be replaced as often as necessary.

B. All temporary filters shall be held securely in place and with minimum bypass. Filters shall be changed as needed.

C. Systems shall not be operated without filters equaled to specified filters in place to protect coils and other heat exchanger devices.

3.2 SPARE FILTERS:

A. The spare set of filters shall be delivered to the Owner's warehouse facility within 25 miles of the project site.

END OF SECTION 23 4100

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SECTION 23 9005 - HEAT TRANSFER (ELECTRIC COOLING)

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of heat transfer equipment and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0502 - Common HVAC Materials

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
 - a. ARI Standards 210/240, 340, and 360
 - b. ANSI Z21.47/UL - Unitary Air Conditioning Standard for Safety Requirements
 - c. Underwriter's Laboratory
 - d. NFPA 90A
 - e. AMCA 210 Test Code For Air Moving Devices
 - f. National Electric Code
 - g. ASHRAE 15 - Safety Code for Mechanical Refrigeration
- B. All motors and equipment shall be U.L. labeled.
- C. All insulation and materials shall have a flame spread rating of less than 25 and smoke developed of less than 50.
- D. All heating and cooling equipment shall bear the ARI seal.

- E. All coils shall be ARI certified.
- F. All electric heaters shall have impedance protection per UL519.
- G. All outdoor cabinets shall meet or exceed the 500 hour salt spray test unless more stringent tests are specified.
- H. Manufacturers:
 - 1. The following constant volume packaged heating and cooling unit manufacturers with hot gas reheat are acceptable:
 - a. Trane
 - b. Approved Equal
 - 2. The following ductless split system cooling unit manufacturers (indoor wall mount) are acceptable:
 - a. Trane
 - b. Daikin
 - c. LG
 - d. Mitsubishi

PART 2 - PRODUCTS

2.1 CONSTANT VOLUME HEAT PUMPS:

- A. General:
 - 1. Equipment shall meet or exceed the scheduled efficiencies or ASHRAE 90.1, whichever is greater.
 - 2. Furnish and install heating and cooling units in accordance with the drawings and as specified hereinafter.
 - 3. Unit shall be factory assembled and tested.
 - 4. Refrigerant shall be R410A.
 - 5. Motors shall be premium efficiency.
- B. Outdoor Cabinets:
 - 1. Unit shall be designed for outdoor installation.

2. Cabinet shall be insulated and constructed of heavy duty galvanized steel. Frame and panels shall be 18 gauge minimum. They shall be zinc coated or epoxy coated with a baked-on finish.
 3. Prewired control panel.
 4. Hinged access doors with quick release handles.
 5. Single wall cabinets shall be thermally and acoustically insulated with a minimum of R4 fiber insulation. Provide a foil, sprayed neoprene, or mat faced finish.
 6. Outside air intake hood.
- C. Refrigerant Circuits:
1. All units shall have factory installed liquid line filter dryer, liquid line sight glass, pressure tap ports, check valves, and suction and liquid service valves.
 2. Heat pump units shall also have reversing valve, suction line accumulator, and discharge muffler.
 3. Electronic head pressure control shall be provided for low ambient control to 30 deg. F.
- D. Compressors:
1. Dual compressors.
 2. Compressor shall have centrifugal oil pump.
 3. Motor shall have internal temperature and current sensing motor.
 4. Compressor shall have totally dipped hermetic motor windings.
 5. Compressor shall be resiliently mounted and seismically isolated.
- E. Outdoor Coil:
1. The outdoor coil shall be constructed of aluminum spine fin mechanical bonded to seamless aluminum or copper tubing with all joints brazed.
 2. Surface shall be engineered to facilitate defrost water runoff.
 3. Louvered panels.
 4. Factory epoxy coating on the condenser coil.
- F. Indoor Coil:
1. The indoor coil shall be constructed of aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed.

2. Coil shall include factory installed refrigerant metering device and refrigerant line fittings.
- G. Outdoor Fans:
1. Fan motors shall be permanently lubricated, weatherproof motors suitable for outdoor use.
 2. Motor shall have built-in current and thermal overload protection.
 3. Fans shall be resiliently mounted and seismically isolated.
 4. Fans shall be statically and dynamically balanced.
 5. Provide PVC coated fan guard.
- H. Indoor Fan:
1. Indoor fan shall be direct drive plenum fan with ECM motor and speed adjustment feature or inverter duty motor with a variable frequency drive.
 2. Fan shall be seismically isolated.
- I. Safeties:
1. Heat pumps shall have a solid state defrost control. Defrost shall occur only when coil saturated suction temperature indicates freezing temperatures. Defrosting shall be limited to a maximum of 10 minutes over a 90 minute period.
 2. Provide a time-guard device to prevent compressor recycling by requiring a 5-minute delay before restarting.
 3. Three phase protection.
- J. Electrical (Outdoor Unit):
1. Provide control voltage transformer.
 2. Provide transformer for motor or heaters as required.
 3. Transformers shall be factory mounted and wired.
 4. Power to the packaged unit shall be through the interior of the unit curb.
- K. Electric Heaters:
1. Heaters shall have a total output as scheduled on drawings.
 2. Each heater assembly shall include power supply fusing if over 48 amps, automatic resetting limit switches and heat limiters for thermal protection.

3. Heaters shall be provided with polarized plug for quick connection to unit low voltage wiring.
 4. Electric heaters factory furnished and installed capacity not to exceed scheduled capacity at rated voltage.
 5. If larger heaters are supplied, they shall not be large enough to require larger supply wiring or disconnects.
- L. Refrigerant Circuit (Units with Hot Gas Reheat):
1. Provide full modulating control of hot gas reheat.
 2. Reheat control shall maintain space setpoint to ± 2 degrees F.
 3. Discharge air temperature shall be adjustable from the building automation control system.
- M. Drain Pan:
1. Provide dual slope insulated non corrosive drain pan.
- N. Filters:
1. Provide flat filter rack for 2 inch pre filter.
 2. Where additional filters are specified, additional filter racks shall be provided for the additional filters.
- O. Outside Air Intake:
1. Provide outside air intake hoods with birdscreen when outside is specified directly from outdoors.
 2. Settable low leak, motorized, outside air dampers.
 3. See Instrumentation and Control for HVAC specification for airflow measuring requirements.
- P. Provide BacNet communication card on all equipment.
- Q. Controls:
1. The unit shall be provided with digital controls to provide the specified sequence of operation. See the Sequence of Operations specification.
 2. Space temperature and humidity sensors shall be capable of controlling the unit in cooling, heating, and dehumidification modes.

2.2 SPLIT SYSTEM UNITS (DUCTLESS):

A. Controls:

1. Provide a control wiring terminal board in the outdoor unit to match the indoor unit terminal board and thermostat terminals.
2. Airflow switch interlocked with condenser operation.
3. Hard wired thermostat (with 24 hour time clock control.)
4. Unit shall operate in cooling to 20 degrees F ambient.

B. Indoor Wall Mounted Unit:

1. Unit shall be compact, lightweight design suitable for wall mounting.

C. Outdoor Coil:

1. Factory applied epoxy coating on the condenser coil.

D. Filters:

1. Washable filter

E. Accessories:

1. Condensate pump
2. Heavy duty PVC enclosure over exposed utilities (refrigerant lines, drain lines, etc.)

F. Electrical:

1. Factory disconnect on indoor unit.

2.3 CONDENSATE PUMPS (DUCTLESS SPLIT SYSTEMS):

A. General:

1. This pump shall replace any factory supplied pump.
2. The pump shall be powered from the indoor unit.

B. Pump:

1. Piston pump
2. Electronic water sensing
3. High water cutout and anti-siphon fitting

4. Condensate filter
 5. 22 db A @ 3.3 ft.
 6. 120/1 power
 7. 2.0 GPH @ 20 ft. lift at 0 ft. suction.
- C. Wall Mounted Unit:
1. The pump shall be designed to fit in or directly beneath the wall mounted unit.
 2. If external to the wall mounted unit, the pump shall be in a casing similar to the wall mounted unit.
- D. Ceiling Cassette:
1. The pump shall be similar to the wall mounted unit pump.
- E. Accessories:
1. Covers for the refrigerant and drain lines. Covers shall match the unit construction.
- F. Basis of design manufacturer shall be:
1. Sauermann

PART 3 - EXECUTION

3.1 CONDENSATE DRAIN LINES:

- A. Provide a weather seal grommet where drain penetrates casing and wall sleeve.

3.2 WARRANTY:

- A. When a compressor fails within the warranty period, the compressor shall be replaced.
- B. If the system has multiple compressors on a single refrigerant circuit, and one compressor fails, all compressors shall be replaced during the warranty period.

END OF SECTION 23 9005

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SECTION 26 0500 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL CONDITIONS

1.1 WORK INCLUDED:

- A. The work covered under these sections of the specifications consists of furnishing labor, equipment, supplies and materials, and of performing operations, including cutting, channeling, chasing, excavating and backfilling necessary for the installation of wiring systems, raceways, wiring, and electrical equipment in accordance with this section of the specifications and the accompanying drawings.
- B. The Electrical Work shall include, but not be limited to, the following:
 - 1. Raceway systems
 - 2. Conductors and cables
 - 3. Wiring devices

1.2 RELATED WORK:

- A. Related work to Division 26:
 - 1. Division 1
 - 2. The provisions, conditions, and requirements preceding and including general and supplemental conditions apply to and are a part of Divisions 26, 27 and 28.

1.3 DEFINITIONS:

- A. Provide: Furnish and install complete ready for use, including all accessories required for operation.
- B. Furnish: Purchase and deliver to the project site complete with every necessary appurtenance, support and accessories required for operation.
- C. Install: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.

1.4 DESCRIPTION OF SYSTEMS:

- A. Furnish and install all materials for systems, resulting upon completion, in functioning systems in compliance with performance requirements specified. The omission of express reference to any parts necessary for or reasonably incidental to a complete installation shall not be construed as a release from furnishing such parts.

1.5 QUALITY ASSURANCE:

- A. Equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service.

- B. All equipment of one type (such as panelboards, breakers, etc.) shall be the products of one manufacturer.

1.6 REQUIREMENTS OF REGULATORY AGENCIES/CODE COMPLIANCE:

- A. Contractors shall submit all items necessary to obtain all required permits to the appropriate Regulatory Agencies, obtain all required permits, and pay all required fees.
- B. All work shall conform to the following Building Codes:
 - 1. National Electrical Code (NEC-2017)
 - 2. South Carolina Building Code (SCBC 2018)
- C. All work shall conform to all federal, state and local ordinances.
- D. References to the National Electrical Code and National Fire Protection Association (NFPA) are a minimum installation requirement standard. Design drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the NEC and NFPA.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

- A. All products shall be new (except where noted) and unused and without blemish or defect.

PART 3 - EXECUTION

END OF SECTION 26 0500

SECTION 26 0501 - ELECTRICAL COORDINATION

PART 1 - GENERAL CONDITIONS

1.1 INTERPRETATION OF CONTRACT DOCUMENTS:

- A. This section of the specifications and related drawings describe general provisions applicable to every section of Division 26.
- B. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- C. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not eliminate the requirement for field coordination for the indicated work.
- D. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.

1.2 EXISTING CONDITIONS:

- A. Bidders shall visit the premises and thoroughly familiarize themselves with details of the work, working conditions, verify dimensions in the field, advise the Architect/Engineer of any discrepancy, and submit shop drawings of any changes he proposes to make, in quadruplicate for approval, before starting the work. Contractor shall install equipment in a manner to avoid building interference.

1.3 SHOP DRAWINGS:

- A. Do not purchase any materials or equipment prior to receipt of approved shop drawings.
- B. Prior to assembling or installing the work, prepare and submit shop drawings for the following items electrical equipment as specified in subsequent sections.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements.
- D. Catalog cuts submitted for approval shall be legible and shall clearly identify equipment being submitted. Items that have been faxed or scanned are not acceptable.
- E. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1.4 AS-BUILT DRAWINGS:

- A. The installer shall keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of items, material, and equipment on these record set drawings.

1.5 OPERATING AND MAINTENANCE INSTRUCTIONS:

- A. After final tests and adjustments instruct the Owner's Representative in the details of operation and maintenance for equipment installed.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION:

- A. In addition to the requirements of the National Electrical Code, install an identification sign which will clearly indicate information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchgear and motor control assemblies, control devices and other significant equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core and engraved lettering, a minimum of 1/4-inch high. Nameplates that are furnished by manufacturer, as a standard catalog item, or where other methods of identification are herein specified, are exceptions.
 - 1. Nameplates shall be attached with screws or rivets.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS:

- A. Inspection:
 - 1. Prior to any Work, the Contractor shall carefully inspect the installed Work of other Trades and verify that such Work is complete to the point where his installation may properly commence.
 - 2. Verify that equipment may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the Architect Engineer.
 - 2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.
- C. Return to original (pre-construction) condition any paved areas, sidewalks, planting, etc., disturbed during electrical system installation.

3.2 INSTALLATION:

- A. Install equipment in strict accordance with the manufacturer's recommendations and the shop drawings approved by the Engineer.
- B. Secure equipment using fasteners suitable for the use, materials, and loads encountered. If requested, submit evidence proving suitability. Do not attach electrical materials to roof decking, removable or knockout panels, or temporary walls and partitions, unless indicated otherwise.
- C. Equipment location: Shall be as close as practicable to locations shown on drawings.
- D. Working spaces shall be not less than specified in the National Electrical Code for voltages specified.
- E. Equipment and Materials:
 - 1. New equipment and materials shall be installed unless otherwise specified.
 - 2. Equipment and materials shall be designed to assure satisfactory operation and operating life for environmental conditions where being installed. NEC and other code requirements shall apply to the installation in areas requiring special protection such as explosion-proof, vapor-proof, watertight and weatherproof construction.

3.3 COORDINATION WITH OTHER TRADES:

- A. Coordinate work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings and shall make sure that proposed equipment can be accommodated. If interferences occur, Contractor shall bring them to the attention of Architect/Engineer, in writing, prior to signing of contract; or, Contractor shall, at his own expense, provide proper materials, equipment, and labor to correct any damage due to defects in his work caused by such interferences.

3.4 WORK PERFORMANCE:

- A. Arrange, phase and perform work to assure uninterrupted electrical service for other buildings. See General Methods of Procedure under Section GENERAL REQUIREMENTS.
- B. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior condition.
- C. Coordinate location of equipment and conduit with other trades to minimize interferences.
- D. Cutting of Holes:
 - 1. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed.

2. Holes shall be located so as not to affect structural sections such as ribs or beams.
 3. Holes shall be laid out in advance. The Architect shall be advised prior to drilling through structural sections, for determination of proper layout.
- E. Where conduits, wireways, busduct, and other electrical raceways pass through fire partitions, fire walls or walls and floors, install a UL listed firestop assembly that matches the rating and is intended for the penetrated construction to provide an effective barrier against the spread of fire, smoke and gases. Penetrations shall be made and the fire-stopping installed in accordance with manufacturers written instructions and UL details.

3.5 PROTECTION AND CLEANING OF SYSTEMS AND EQUIPMENT:

- A. Protect materials and equipment from damage during storage at the Site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.
- B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering them with securely fastened protective rigid or flexible waterproof coverings.
- C. Conduit shall be protected by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation in the piping.
- D. During construction cap the top of conduits and raceway installed vertically.
- E. During installation, equipment, controls, controllers, circuit protective devices, etc., shall be protected against entry of foreign matter on the inside; and be vacuum cleaned both inside and outside before testing, operating and painting.
- F. Damaged equipment shall be placed in first class operating condition or be returned to source of supply for repair or replacement.
- G. Painted surfaces shall be protected with removable heavy kraft paper, sheet vinyl or equal, installed at the factory, and removed prior to final inspection.
- H. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with same quality of paint and workmanship as used by manufacturer so repaired areas are not obvious.

3.6 DISPOSITION OF EXISTING MATERIAL AND EQUIPMENT:

- A. Carefully remove and store on the site material and equipment noted or specified to be reused or relocated. Thoroughly clean this equipment prior to installation.
- B. Remove other materials or debris resulting from demolition operations from the site.

3.7 IDENTIFICATION:

- A. Upper case letters of uniform height; centered on device, coverplate, or enclosure; engraved letters filled with a contrasting color; and characters made clearly and distinctly.

- B. Use abbreviations defined in the contract documents whenever possible. Use plan designations for labeling, unless indicated otherwise. Indicate loads served using designations from electrical schedules and designations from the trade furnishing the equipment served.
- C. Label inside covers in exterior locations and outside covers in unfinished areas of the following with a permanent ink marking pen:
1. Junction boxes or portions of junction boxes with 277 or 480 volt wiring;
 2. Communications system pull and junction boxes
 3. Pull, junction boxes, and raceway installed above ceilings and for future use.
- D. Label feeder conductors and branch circuit conductors with self adhesive, numbered labeling tapes; Brady Co. or equal. Indicate feeder numbers on feeders and terminal numbers for control conductors. Label conductors at origin and destination points and at junction boxes where two or more feeder or control circuits are present.
- 3.8 ACCESS TO EQUIPMENT:
- A. All equipment shall be installed in location and manner that will allow for convenient access for maintenance and inspection.
- 3.9 CONNECTION OF EQUIPMENT FURNISHED AND INSTALLED UNDER OTHER DIVISIONS OF THE WORK:
- A. Rough-in and make final electrical connection to equipment requiring electrical connections with such equipment being furnished and installed under other Divisions of the Work.
- B. Provide whatever incidental devices are necessary for final connection, such as, but not necessarily limited to outlet boxes, receptacles, connectors, clamps and switches.
- 3.10 GENERAL COMPLETION AND DEMONSTRATION:
- A. Results expected:
1. Systems shall be complete and operational, and controls shall be set and calibrated.
 2. Testing, start-up and cleaning work shall be complete.
- 3.11 CLEANING:
- A. Periodically during construction and prior to Owner acceptance of the building, Contractor shall remove from the premises and dispose of packing material and debris.

- B. Clear away debris and surplus material resulting from electrical work. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

END OF SECTION 26 0501

SECTION 26 0503 - CUTTING, PATCHING AND REPAIR

PART 1 - GENERAL REQUIREMENTS

1.1 SCOPE OF WORK:

- A. Cutting: Furnish all labor, materials, tools and equipment and perform all operations in connection with the cutting of new and existing building structure, finishes and building assemblies as specified hereinafter.
- B. Patching: Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of watertight sealant as required to seal voids or gaps around Division 26000 equipment at penetrations through exterior floors, walls, and roof systems.
- C. Repair: Furnish all labor, materials, tools and equipment required to repair all existing or new building components and finishes, outside components, landscaping, utilities, or other appurtenances that are damaged as a result of the performance of this contract.
- D. All existing utilities, feeders, branch circuits, signal wiring, control wiring, etc. shall be reconnected to new or existing systems as required to maintain the same functions as existed prior to new work.

1.2 QUALITY ASSURANCE:

- A. Sealants shall equal or exceed all requirements of ASTM E-814.
- B. All applicable codes as stated elsewhere in these specifications for the type of work performed.

PART 2 - PRODUCTS

2.1 WATERPROOFING:

- A. Exterior joint sealant shall be Polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding; colors selected by Architect/Engineer.
- B. The following waterproofing sealant manufacturers are acceptable:
 - 1. TREMCO
 - 2. Sonneborn - Contech
 - 3. W. R. Meadows

PART 3 - EXECUTION

3.1 GENERAL:

- A. Patch and repair all building finishes, structural components, or other appurtenances that are damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.
- B. Replace all building components, outside components, shrubbery, or other appurtenances which are damaged beyond repair. Replacement item(s) shall be of equal or higher quality than the original item(s).
- C. All penetrations thru exterior floors, walls, and roof systems shall be sealed watertight.
- D. All roof penetrations shall be patched in accordance with roofing manufacturers' recommendations.
- E. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

3.2 INSTALLATION OF SEALANT MATERIALS:

- A. Install materials in accordance with manufacturer's recommendations for installation of these materials.
- B. Clean and prepare joints for sealant application in accordance with manufacturer's recommendations. Ensure that joint forming materials are compatible with sealant. Use joint filler to achieve required joint depths. Apply primers as recommended by sealant manufacturer.
- C. Openings larger than required for proper installation of electrical raceways or conduits shall be patched or repaired.

END OF SECTION 26 0503

SECTION 26 0519 - WIRE AND CABLE - BUILDING WIRE (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 SCOPE:

- A. This section includes the furnishing, installation, and connection of the building wire for power and lighting circuits.
- B. Unless otherwise specified in other sections of these specifications, control wiring shall be provided, installed, and connected to perform the functions specified in other sections of these specifications.
- C. Unless otherwise specified in other sections of these specifications, communication and signal wiring shall be provided, installed, and connected to perform the function specified in other sections of these specifications.

1.2 APPLICABLE PUBLICATIONS:

- A. The following specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this specification to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of Invitation for Bids shall be applicable. In text such specifications and standards are referred to by basic designation only.
 - 1. National Fire Protection Association (NFPA) Publications
 - No. 70National Electrical Code (NEC)
 - 2. Underwriters' Laboratories, Inc. (UL) Publications:
 - No. 44Rubber-Insulated Wire and Cables
 - No. 83Thermoplastic-Insulated Wires
 - No 493Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables
 - No. 486.Wire Connectors and Soldering Lugs

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Building Wire (Power and Lighting):
 - 1. Cable and wire shall be in accordance with UL, NEC, as shown on the drawings, and as hereinafter specified.

2. Conductors:
- a. Shall be annealed copper.
 - b. Shall be stranded for sizes No. 8 and larger. Sizes No. 10, and smaller shall be solid.
 - c. Size shall be not less than shown on the drawings. Minimum size shall be No. 12 AWG.
3. Insulation: Unless otherwise shown on the drawings, insulation shall be as follows:
- a. THHN - THWN – Dry, Damp, Wet Locations
 - b. XHHW – Dry, Damp, Wet Locations.
4. Color Code:
- a. All secondary service, feeder, and branch circuit conductors shall be color coded as follows:

| <u>208/120 Volt</u> | <u>Phase</u> | <u>480/277 Volt</u> |
|---------------------|--------------|---------------------|
| Black | A | Brown |
| Red | B | Orange |
| Blue | C | Yellow |
| White | Neutral | Gray |
 - b. All No. 12 and No. 10 branch circuit conductors shall have solid color compound or solid color coating.
 - c. No. 8 AWG and larger phase conductors shall have either:
 - 1) Solid color compound or solid color coating.
 - 2) Stripes, bands, or hash marks of colors specified above.
 - 3) Colored pressure-sensitive plastic tape. Tape shall be applied in half overlapping turns for a minimum of three inches for all terminal points, and in all junction boxes, pull boxes, troughs, manholes, and handholes. Tape shall be 3/4-inch wide with colors as specified above. The last two laps of tape shall be applied with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
 - d. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

- B. Splices and Joints:
1. Shall be in accordance with UL and NEC.
 2. Branch circuits (No. 10 AWG and smaller):
 - a. Connectors shall be solderless, screw-on, pressure cable type, 600 volt, 105 degree C, with integral insulation. They shall be approved for copper conductors, and shall be reusable.
 - b. The integral insulator shall have a skirt to completely cover the stripped wires.
 - c. The number, size, and combination of conductors as listed on the manufacturers packaging shall be strictly complied with.
 3. Feeder Circuits:
 - a. Connectors shall be indent, hex screw, or bolt clamp-type. Material shall be high conductivity and corrosion-resistant.
 - b. Connectors for cable sizes 250 MCM and larger shall have not less than two compression indents.
 - c. Splices and joints shall be insulated with materials approved for the particular use, location, voltage, and temperature. Insulation shall be not less than that of the conductors being joined.
 - d. Plastic electrical insulating tape:
 - 1) Tape shall be flame retardant, cold and weather resistant.
- C. Control Wiring:
1. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring.
 2. Wire size shall be large enough so that the voltage drop under inrush conditions will not adversely affect operation of the controls.
- D. Wire Lubricating Compound shall be suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. All wiring shall be installed in raceway systems. Installation shall be in accordance with the NEC, as shown on the drawings, and as hereinafter specified.
- B. Cables and wires shall be spliced only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.

C. Wire Pulling:

1. Suitable installation equipment shall be provided to prevent cutting or abrasion of conduits during pulling of feeders.
2. Ropes used for pulling feeders shall be made of suitable nonmetallic material.
3. Pulling lines for feeders shall be attached by means of either woven basket grips or pulling eyes attached directly to the conductors.
4. All cables to be pulled in a single conduit shall be pulled in together.

3.2 FIELD TESTING:

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Test shall be performed by megger and conductors shall test free from short-circuits, grounds, and opens.
- C. Conductors shall be tested phase-to-phase and phase-to-ground.

END OF SECTION 26 0519

SECTION 26 0526 - GROUNDING

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. This section includes the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounding systems.
- B. The term ground, as used in this specification, shall mean any or all of the grounding types specified.

1.2 QUALITY ASSURANCE:

- A. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment and wiring. Provide grounding products which are UL listed and labeled.
- B. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical grounding and bonding.
- C. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

PART 2 - PRODUCTION

2.1 GENERAL:

- A. Provide electrical grounding systems with assembly of materials, including cables/wires, connectors, terminals, solderless lugs, grounding rod/electrodes, bonding jumper braid and additional accessories needed for complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE and established industry standards.

2.2 GROUNDING CONDUCTORS:

- A. Shall be UL and NEC approved types, copper, with insulation color identified green, except where otherwise shown on the drawings, or specified.
- B. Wire size shall not be less than #12 AWG and not less than required by the NEC.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL GROUNDING:

- A. General: Install electrical grounding systems in accordance with applicable portions of NEC, with NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.

3.2 FEEDERS AND BRANCH CIRCUITS:

- A. Install green insulated equipment grounding conductors with all feeders and branch circuits. Conductors shall be sized in accordance with NEC Article 250.

3.3 EQUIPMENT GROUNDS:

- A. All equipment that has electrical connections (lights, receptacles, panels, and utilization equipment) shall have a ground wire connected that is directly tied to the ground bus of the panel which serves it.
- B. Fixed electrical appliances and equipment shall have a ground lug installed and provided by this contractor for termination of the green ground conductor.

END OF SECTION 26 0526

SECTION 26 0533 - CONDUITS/RACEWAYS AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE:

- A. This section includes the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems.
- B. Types of raceways in this section include the following:
 - 1. Rigid metal conduit (RMC or GRC)
 - 2. Intermediate metal conduit (IMC)
 - 3. Electrical metallic tubing (EMT)
 - 4. Flexible metal conduit (FMT)
 - 5. Liquidtight flexible metal conduit (LFMC)
 - 6. Rigid PVC conduit (PVC)
- C. The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 QUALITY ASSURANCE:

- A. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
- B. UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to raceways systems; and, provide products and components which have been UL listed and labeled.
- C. NEC Compliance: Comply with requirements as applicable to construction and installation of raceway systems.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC OR GRC):

- A. Rigid metal steel conduit shall conform to ANSI C80.1 and Underwriter's Laboratories UL-6 specification, ANSI C80.1.
- B. Conduit shall be hot-dipped galvanized to provide a corrosion resistant coating.
- C. Fittings: Fittings shall be ANSI/NEMA FB 1 threaded type, hot dipped or electronic plated. Threaded conduit to be secured to boxes, cabinets, etc., by means of galvanized threaded bushings on the inside and bond-type locknuts on the inside and outside of such

boxes and cabinets. Fittings shall be watertight and the same material as conduit installed with factory manufactured elbows.

2.2 RIGID INTERMEDIATE STEEL CONDUIT (IMC):

- A. Intermediate Metallic Conduit shall conform to ANSI C80.1 and proposed Underwriter's Laboratories UL 1242 specification.
- B. Conduit shall be hot-dipped galvanized to provide a corrosion resistant coating. Intermediate Metallic Conduit (IMC) shall have galvanized/metallized thread protection, and pipe interior shall be protected by corrosion inhibiting coating.
- C. Fittings: Shall be similar to GRC.
- D. Maximum allowable size shall be (4) inches.

2.3 ELECTRICAL METALLIC TUBING (EMT):

- A. Electrical metallic tubing shall conform to ANSI C80.3 and Underwriter's Laboratories UL 797.
- B. EMT shall be hot-dipped galvanized steel with internal coating of silicone epoxy lubricant to assist in wire pulling.
- C. Fittings: Shall be compression type, steel or malleable iron. Set screw or indentation type of fittings are not acceptable.

2.4 FLEXIBLE METAL CONDUIT (FMC):

- A. Flexible metal conduit shall conform to UL 1.
- B. Flexible conduit to be of hot-dipped galvanized interlocked spirally wound steel strip.
- C. Fittings shall be multiple point type, threading into the internal wall of the conduit convolutions, and shall have insulated throat. Connectors to be galvanized and be suitable for connection to associated boxes and conduits.

2.5 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC):

- A. Liquid-tight flexible metal conduit shall conform to UL 360.
- B. Liquid-tight flexible metal conduit shall consist of flexible galvanized steel tubing over which is extruded a liquid-tight jacket of polyvinyl chloride (PVC). Conduit shall be provided with a continuous copper bonding conductor wound spirally between the convolutions.
- C. Fittings used shall be reusable type of malleable iron/steel construction, electro zinc plated inside and outside, furnished with nylon insulated throat and taper threaded hub. Connectors to be galvanized and be suitable for connection to associated boxes and conduits.

2.6 RIGID PVC (PVC):

- A. Conduit shall be UL rated 90°C and to UL-651. Fittings shall conform to UL-514.
- B. Conduit shall be S40 wall thickness made from polyvinyl chloride (recognized by UL) compound which includes inert modifier to improve weatherability and heat distortion. Conduit and couplings shall be homogenous plastic material free from visible cracks, holes, or foreign inclusions. Conduit bore shall be smooth and free from blisters, nicks, or other imperfections which could mar conductors or cables.
- C. Bends: 90° bends shall be made with galvanized rigid steel elbows. Bends other than 90° shall be made from S80 PVC conduit.

2.7 CONDUIT SUPPORTS:

- A. Parts and hardware shall be zinc-coated or have equivalent corrosion protection.
- B. Pipe straps: Fed. Spec. FF-S-760, type 1, style A or B.
- C. Individual conduit hangers: Shall be designed for the purpose, and have pre-assembled closure bolt and nut, and provisions for receiving hanger rod.
- D. Multiple conduit (trapeze) hangers shall be not less than 1-1/2 x 1-1/2 inch, 12 gage steel, cold formed, lipped channels. Hanger rods shall be not less than 3/8 inch diameter steel.
- E. Solid masonry and concrete anchors: Fed. Spec. FF-S-325 shall apply. Anchors shall be GROUP III self-drilling expansion shields, or machine bolt expansion anchors GROUP II type 2 or 4, or GROUP VII.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION SCHEDULE:

- A. Conduits utilized shall be metallic conduit types listed in this specification. Metallic conduit types shall be applied for specific system types as follows:
 - 1. Power distribution feeders such as feeders for switchboards, panelboard, transformers, etc.:
 - a. Exposed or concealed - RMC or IMC
 - b. Below slabs on grade or underground outside of building - PVC
 - 2. Feeders to motors: Same requirements as power distribution feeders.
 - 3. Branch circuits from panelboards (not described above):
 - a. Wet or damp locations exposed or concealed - RMC or IMC
 - b. Dry locations exposed or concealed - EMT.
 - c. Below slabs on grade or underground outside of building - PVC

4. Low voltage systems such as building automation and control systems, information technology systems: Same requirements as branch circuits.

3.2 CONDUIT INSTALLATION:

- A. Installation shall be in accordance with UL, NEC, as shown on the drawings, and as hereinafter specified.
- B. Contractor shall lay out and install conduit runs to avoid proximity to hot pipes. In no case will a conduit be run within three inches of such pipes, except where crossings are unavoidable and then conduit shall be kept at least one inch from the covering on pipe crossed.
- C. Conduits shall be supported as required to comply with applicable paragraphs of the NEC.
- D. Conduit installation shall be as follows:
 1. Installed as complete runs before pulling in cables or wires.
 2. Installed so they will not obstruct head room, walkways, doorways or work by other trades.
 3. Cut square with a hacksaw, reamed, burrs removed, and drawn up tight.
 4. Mechanically continuous.
 - a. Metallic raceway shall also be electrically continuous.
 5. Supported within one foot of changes of direction, and within one foot of each enclosure to which connected.
 6. Ends of empty conduit to be closed with plugs or caps at rough-in stage to prevent entry of debris until wires are pulled in.
 7. Conduits shall be secured to cabinets, junction boxes, pull boxes, and outlet boxes by bonding type locknuts.
 8. See architectural detail for conduit penetrations of roof membrane.
- E. Conduit Bends:
 1. Shall be made with standard conduit bending machines.
 2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
 3. Conduits shall not be bent with a pipe tee or vice.
- F. Conduit shall be securely fastened in place at intervals as specified by the code using suitable straps, hangers and other supporting assemblies. Strap hangers and supporting assemblies:

1. Shall be of rugged construction capable of supporting weight with a reasonable factor of safety.
 2. Spacers and supporting straps shall be of rugged malleable iron or steel construction hot dipped galvanized.
 3. Shall be adequately protected against corrosion.
- G. In wet locations or in locations where corrosive conditions are present, vertical and horizontal runs of conduit shall be firmly supported so that there is at least 1/4" air space between the conduit and the wall or supporting surface. Spacers and supporting straps shall be of malleable iron construction, hot dipped galvanized.
- H. Flexible conduit when installed shall have sufficient slack to avoid sharp flexing and straining due to vibration and thermal expansion/construction. Conduit shall be installed in such a manner that liquids will tend to run off the surface instead of draining towards the fittings.
- I. Concealed work installation:
1. In cast-in-place:
 - a. Conduits may be installed in concrete that is at least than 3 times conduit trade size in thickness but in no case less than 3" thick.
 - b. Conduit shall be run in direct lines.
 - c. Conduit may be installed through concrete beams where shown on the structural drawings or as approved by the Engineer prior to installation.
 - 1) Submit drawings showing locations size, and position of each proposed penetration for review prior to installation.
 - d. Spacing between conduits in slab shall be approximately six conduit diameters apart except one conduit diameter at conduit crossings.
 - e. Conduits shall be installed approximately at the center of the slab.
 - f. Couplings and connections shall be concrete tight. Thread compounds shall be UL approved conductive type to ensure low resistance ground continuity through the conduits.
 2. In CMU (Concrete Masonry Unit) Walls:
 - a. Conduits shall run vertically within CMU walls except where noted on the drawings or as approved by the Engineer prior to construction.
 3. Conduit shall be run parallel or perpendicular to the building lines.
 4. Branch circuit conduits, and conduits feeding ceiling lighting shall be supported independently from suspended ceiling, lighting fixtures, or air conditioning ducts.

5. Recessed lighting fixtures shall be connected to conduit with not over six feet of flexible metal conduit.
- J. Exposed work installation:
1. Conduit shall be run parallel or perpendicular to the building lines.
 2. Horizontal runs shall be installed close to the ceiling or beams and secured with approved conduit straps.
 3. Horizontal or vertical runs shall be supported at not over eight foot intervals.
- K. Installation underground or below slabs on grade:
1. Tops of conduits shall be:
 - a. Not less than 24 inches and not less than shown on the drawings below finished grade.
 - b. Not less than 30 inches and not less than shown on the drawings below road and other paved surfaces.
 2. Conduits shall be installed below power company direct burial primary feeders where encountered. Coordinate spacing below primary feeder with utility company.
 3. Underground conduits shall be encased in not less than 3" of red cast-in-place concrete (all around) where run outside of buildings or equipment pads.
- L. Transition from PVC to metallic conduit:
1. Where PVC conduit exits permitted locations, coated rigid galvanized or IMC conduits shall be utilized for the transition. Acceptable coatings are factory applied PVC or field applied spray bituminous or tape coatings intended for the application.
 - a. Where conduits transition under pad-mounted equipment enclosures such as switchboards, generators or pad-mounted transformers, it shall be acceptable to utilize PVC for the transition.
 2. Transition to metallic conduits shall occur minimum 12 times conduit trade diameter prior to exit from permitted locations. Distance shall be measured from point of exit for horizontal transitions and from center of conduit at point of exit for horizontal to vertical transitions.
- M. Surface metal raceways:
1. Surface metal raceways shall be used only where shown on the drawings.

3.3 MOTORS AND VIBRATING EQUIPMENT:

- A. Flexible metal conduit shall be used for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Flexible metal conduit shall be liquid-tight when installed in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, and locations subject to seepage or dripping of oil, grease or water. Flexible metal conduit shall be installed with green ground wire.

3.4 CONDUIT SUPPORTS, INSTALLATION:

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Pipe straps or individual conduit hangers shall be used for supporting individual conduits.
- C. Multiple conduit runs shall be supported by trapeze hangers. Trapeze hangers shall be designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 pounds. Each conduit shall be attached by U-bolt or other approved fastener.
- D. Conduit shall be supported independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, etc.
- E. Solid Masonry and Concrete: Fasteners shall be as follows:
 - 1. New construction: Generally, steel or malleable iron concrete inserts in concrete prior to pouring.
 - 2. Existing construction:
 - a. Steel expansion anchors not less than 1/4-inch bolt size and not less than 1-1/8 inch embedment.
 - b. Power set fasteners shall be approved, and not less than 1/4-inch diameter with depth of penetration not less than three inches.
 - c. Anchors or fasteners attached to concrete ceilings shall be vibration and shock resistant.
- F. Hollow masonry. Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.
- G. Metal structures. Fasteners shall be machine screw or devices specifically designed and approved for the application.

3.5 LOW VOLTAGE SYSTEM CONDUIT:

- A. Minimum size conduit shall be 3/4", but not less than shown on the drawings.
- B. Conduit bends and elbows shall be long radius.

3.6 PULL WIRES:

- A. Install a # 14 gauge fish wire in empty conduits, except telephone and communications.
Install a nylon pull string in telephone and communication conduits.

END OF SECTION 26 0533

SECTION 26 0535 - ELECTRICAL BOXES

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. This section includes the furnishing, installation and connection of all outlet boxes, junction boxes, and floor boxes as shown on the drawings or as required to house the intended wiring, devices or equipment.
- B. Types of electrical boxes and fittings specified in this section include the following:
 - 1. Outlet boxes
 - 2. Junction boxes
 - 3. Pull boxes
 - 4. Bushings
 - 5. Locknuts
 - 6. Knockout closures

1.2 QUALITY ASSURANCE:

- A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
- B. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL listed and labeled.
- C. NEMA Compliance: Comply with applicable requirements of NEMA Stds./Pub No.'s OS1, OS2, and Pub 250 pertaining to outlet and device boxes, covers, and box supports.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS:

- A. Outlet and Device Boxes (dry interior locations): Provide galvanized coated sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as required by particular application, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with conduit size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.
- B. Outlet and Device Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs and metal straps for supporting outlet boxes, which are

compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations.

1. Plaster rings and device mounting rings shall be of proper depth such that the device mounting surface is flush with the finished wall/ceiling surface.
- C. Outlet and Device Boxes (damp and wet locations): Provide corrosion resistant cast metal raintight outlet and wiring device boxes of types, shapes and sizes required for each application, including depth of boxes, with threaded conduit holes for fastening electrical conduit, and cast metal face plates. Where weatherproof devices are indicated, provide spring hinged watertight caps suitable configured for each application, including face plate gaskets and corrosion resistant plugs and fasteners.
- D. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suite each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
- E. Bushings, Knockout Closures, and Locknuts: Provide corrosion resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

- A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

3.2 GROUNDING:

- A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION 26 0535

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE:

- A. This section includes the furnishing, installation, and connection of wiring devices as shown on the plans.
- B. Types of electrical wiring devices in this section include the following:
 - 1. Receptacles
 - 2. Switches
 - 3. Faceplates
 - 4. Motor rated toggle switches

1.2 QUALITY ASSURANCE:

- A. NEC Compliance: Comply with NEC as applicable to installation and wiring of electrical wiring devices.

1.3 SUBMITTALS:

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 26 0500, ELECTRICAL GENERAL REQUIREMENTS.
- B. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
- C. The specific item proposed and its area of application shall be marked on the catalog cuts.

PART 2 - PRODUCTS

2.1 FABRICATED WIRING DEVICES:

- A. General: Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated. Unless noted otherwise device color shall be ivory. Wiring devices shall comply with NEMA publications WD1 and WD6.
- B. Receptacles shall comply with Federal Spec WC-596.
- C. Toggle switches shall comply with Federal Spec WS-896.

D. Wiring Devices: 15 and 20A, 120 V devices shall employ modular connections without exposed wiring terminals. Acceptable products are as follows.

- | | | |
|----|-------------|-------------|
| 1. | Legrand/P&S | Plugtail |
| 2. | Hubbell | SnapConnect |
| 3. | Leviton | Lev-Lok |

E. Wiring devices shall be as listed in the following table, or approved equal:

| <u>Description</u> | <u>Legrand</u> | <u>Hubbell</u> | <u>Leviton</u> |
|--|----------------|----------------|----------------|
| 20A 125V 2P 3W Grounded Duplex Tamper Resistant Receptacle (NEMA 5-20R) | PTTR5362I | SNAP5362ITR | M5362-I |
| 20A 125V 2P 3W Grounded Duplex Tamper Resistant Ground Fault Interrupter (NEMA 5-20R) | PT2097TRI | GFTWRST20SNAPI | MGFT2-I |
| 20A 125V 2P 3W Grounded Duplex Ground Fault Interrupter weather resistant (NEMA 5-20R) | 2097TRWR | GFWRST20 | G5362-WTT |
| 30A, 600V 2P Motor Rated Toggle Switch | 7802MD | HBL7832D | MS302-DS |

2.2 WET AND DAMP LOCATION RECEPTACLES:

A. Type "WP" - Wet Locations: Weatherproof receptacles shall be a weather resistant duplex GFCI receptacles as specified under 262726 WIRING DEVICES, Part 2.1.C, mounted in cast metal outlet box fitted with a gasketed "while-in-use" metal cover, Hubbell WP26E or Pass & Seymour WIUC10-CAGV or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES:

- A. Install wiring devices as indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

3.2 GROUNDING:

- A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.3 TESTING:

- A. Prior to energizing circuitry, test wiring for electrical continuity, and for short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 26 2726

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SECTION 26 2816 - SAFETY/DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. This section includes the furnishing, installation, connection, and wiring of safety switches.

1.2 QUALITY ASSURANCE:

- A. Safety/Disconnect switches shall conform to Underwriter's Laboratories UL 98, "Enclosed and Dead-Front Switches."

1.3 SUBMITTALS:

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 260500, ELECTRICAL GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 GENERAL SAFETY/DISCONNECT SWITCH FEATURES:

- A. Switches shall be NEMA type HD (Heavy Duty) and UL listed.
- B. All switches shall have switch blades which are fully visible in the "OFF" position when the switch door is open. All current carrying parts shall be plated to resist corrosion and promote cool operation. Switches shall have removable arc suppressors where necessary to permit easy access to line side lugs. Lugs shall be front removable and UL listed for 60 degrees C and 75 degrees C, aluminum or copper wires.
- C. Switches shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started. The operating handle shall be an integral part of the box, not the cover. Provisions for padlocking the switch in the "OFF" position with at least three locks shall be provided. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open. The handle position shall indicate whether the switch is "ON" or "OFF".
- D. Switches shall be horsepower rated for AC and/or DC as indicated by the plans. All fusible switches rated 100 thru 600 amperes at 240 volts and 30 thru 600 amperes at 600 volts shall have a UL approved method of field conversion from standard Class H fuse spacing to Class J fuse spacing. The switch also must accept Class R fuses and have provisions for field installation of a UL listed rejection feature to reject all fuses except Class R. The UL listed short circuit rating of the switches shall be 200,000 rms symmetrical amperes when Class R or Class J fuses are used with the appropriate rejection scheme. The UL listed short circuit rating of the switch, when equipped with Class H fuses, shall be 10,000 rms symmetrical amperes. 800 and 1200 ampere switches

shall have provisions for Class L fuses and shall have a UL listed short circuit rating of 200,000 rms symmetrical amperes.

- E. Disconnect switches shall be equipped with ground lug.

2.2 NEMA 1 AND 3R HEAVY DUTY SAFETY/DISCONNECT SWITCHES:

- A. Switches shall be furnished in NEMA 1 general purpose enclosures unless exposed to weather which shall be NEMA 3R. Covers on NEMA 1 enclosures shall be attached with pin type hinges. NEMA 3R covers shall be securable in the open position. NEMA 3R enclosures for switches thru 200 amperes shall have provisions for interchangeable bolt-on hubs. Hubs shall be as indicated on the plans. NEMA 3R enclosures shall be manufactured from galvanized steel. Enclosures shall have a gray baked enamel finish, electrodeposited on cleaned, phosphatized steel.

2.3 SPECIFIED MANUFACTURERS:

- A. Specified manufacturers shall be as follows, or approved equal:
 - 1. General Electric
 - 2. Square D
 - 3. Eaton
 - 4. Siemens

PART 3 - EXECUTION

3.1 INSTALLATION LOCATION:

- A. As a general rule, install switches on the equipment it serves, if shown that way on the drawings.
- B. Do not install switch on equipment removable panel.
- C. All switches shall be accessible.

3.2 GROUNDING:

- A. Connect ground wires to ground lug.
- B. See section - GROUNDING.

3.3 CONDUIT BUSHINGS:

- A. Use plastic bushings where conduit enters switch.

END OF SECTION 26 2816