MOHAWK WATER TREATMENT PLANT

STORAGE FACILITY

3600 MOHAWK BOULEVARD, TULSA OKLAHOMA 74115

Project No.: TWUA-W 20-01

CONSTRUCTION DOCUMENT SPECIFICATIONS

APRIL 15, 2021

PREPARED BY:



ENGINEERS AND ARCHITECTS 1623 East 6th Street Tulsa, Oklahoma 74120 918-835-9588

C.A. 262 (PE) RENEWAL DATE: 06-30-2021 C.A. 0049 (ARCH) RENEWAL DATE: 06-31-2022

BKL PROJECT NO: 765

CITY OF TULSA, OKLAHOMA

ENGINEERING SERVICES DEPARTMENT

2317 SOUTH JACKSON TULSA, OK 74107

918-596-9565









04/15/21





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Mohawk Water Treatment Plant Storage Facility TMUA-W 20-01

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SECTION 01100

SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Access to site.
 - 4. Coordination with occupants.
 - 5. Work restrictions.
- B. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

- A. Project Identification: Mohawk Water treatment Plant Storage Facility
 - 1. Project Location: 3600 Mohawk Boulevard, Tulsa, OK.
- B. Owner: City Of Tulsa, 2317 South Jackson Avenue, Tulsa OK 74107
 - 1. Owner's/Field Representative: To be determined.
 - 2. Water Design Lead Engineer: Cheryl Wilson.
- C. Architect: BKL, Inc., 1623 East 6th Street, Tulsa OK 74120

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Construct new pre-engineered storage building with covered parking, concrete apron and other Work indicated in the Contract Documents.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.4 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1.5 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work on this project to normal business working hours of 7 a.m. to 5 p.m., Monday through Friday, excluding city holidays.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner representative not less than one week and again at two days in advance of proposed utility interruptions.
 - 2. Obtain Owner representative's written permission before proceeding with utility interruptions.
- D. Restricted Substances: Use of tobacco products and other controlled substances within the existing building and on Project site is not permitted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012100

ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
- C. Related Requirements:
 - 1. Section 012200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.

1.2 WORK COVEREND BY ALLOWANCE

- A. An allowance has been provided in the contract for additional work not identified in the Construction Documents.
- B. The allowance shall be used for cost of materials, labor, installation and overhead and profit for additional work that is not identified in the Construction Documents/Plans and not included in the base bid pay items.
- C. The allowance shall be used only at the discretion of the City of Tulsa.
- D. The Contractor shall provide to the Owner's Representative a written request for the use of the allowance with a schedule of values and associated backup information.
- E. Contractor shall proceed with work included in the allowance only after receiving a written order from the City of Tulsa Representative authorizing such work. Proceeding with work in the allowance without a written order from the City of Tulsa Representative will be at the Contractor's cost.
- F. At the end of the project any portion of the allowance not used will be credited to the City of Tulsa.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise City of Tulsa Representative of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the City of Tulsa to avoid delaying the Work.
- B. At City of Tulsa Representative's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by City of Tulsa Representative from the designated supplier.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by the City of Tulsa or selected by City of Tulsa Representative under allowance and shall include freight and delivery to Project site.
- B. Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by the City of Tulsa or selected by City of Tulsa Representative under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.6 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. The City of Tulsa reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

END OF SECTION

SECTION 012200

UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for procedures for using unit prices to adjust quantity allowances.

1.2 DEFINITIONS

A. Unit price is an amount proposed by bidders, stated on the Bid Form, applicable during the duration of the Work as 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.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, 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. The City of Tulsa will confirm in field the Contractor's measurement of work-in-place that involves use of established unit prices. If disputes arise, the City of Tulsa 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 City of Tulsa's expense, by an independent surveyor acceptable to Contractor.
- D. If quantities originally contemplated are materially changed in a proposed change so that application of such unit prices to quantities of Work proposed will cause substantial inequity to The City of Tulsa or Contractor, the applicable unit prices shall be equitably adjusted.
- E. List of Unit Prices: Refer to Pay quantity items on the Bid Proposal.

1.4 DESCRIPTION

- A. Work includes:
 - 1. Overhead and profit in Unit Prices.
 - 2. Indicate Unit Prices on Bid Form.
 - 3. Unit Prices indicated on Bid Form will be made part of Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012300

ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 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. ADD ALTERNATE 1: Yard Hydrant
 - 1. Provide and install a yard hydrant with water line. Reference plumbing drawings. Provide all items needed for a complete working product.
- B. ADD ALTERNATE 2: Unit Heaters
 - 1. Provide and install Unit heaters and electrical service as shown on the Mechanical drawings. Include all items necessary for a complete working product.

END OF SECTION

SECTION 012500

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work includes:
 - 1. Product options and substitutions.
 - 2. Administrative and procedural requirements for Substitutions for Cause.
 - 3. Administrative and procedural requirements for Substitutions for Convenience, also consider Substitutions Prior to Bidding.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 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 or Substitution prior to bidding: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. 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.
- 1. 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.
- 2. Owner's Representative's Action: If necessary, Owner's Representative will request additional information or documentation for evaluation within reasonable number of days of receipt of a request for substitution. Owner's Representative will notify Contractor of acceptance or rejection of proposed substitution within reasonable number of days of receipt of request, or of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Owner's Representative's Supplemental Instructions for minor changes in the Work.

1.4 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.
- B. To the greatest extent possible, provide products, materials and equipment of a singular generic kind and from a single source.
- C. Where more than one choice is available as options for Contractor's selection of a product or material, select an option which is compatible with other products and materials already selected.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.
- B. Requirements Included:
 - 1. The Contract is based on the standards of quality established in the Contract Documents.
 - 2. All products proposed for use, including those specified by required attributes and performance shall require approval by the Owner's Representative before being incorporated into the work.
 - 3. Do not substitute materials, equipment or methods unless substitution has been specifically approved for this work by the Owner's Representative and Owner.
- C. Substitutions:
 - 1. Only written requests with complete data for evaluation will be considered.
 - a. Request must be received at least 10 calendar days prior to the bid date.
 - 2. For bidding purposes; base all bids on materials, equipment and procedures specified or approved by Addenda.
 - 3. Addenda listing approved substitutions will be published.
 - 4. No verbal or written approvals other than by Addenda will be valid.
 - 5. After end of that period, requests will only be considered only in case of product unavailability or other conditions beyond the control of Contractor.
 - 6. Submit separate request for each substitution on with the attached form to the Owner's Representative.
 - 7. The Contractor shall support each request with;
 - a. Product identification, including manufacturer's name.
 - b. Manufacturer's literature, marked to indicate specific model, type, size, and options to be considered:
 - 1) Product description.
 - 2) Performance and test data.
 - 3) Reference standards.
 - 4) Difference in power demand, air quantities, etc.
 - 5) Dimensional differences from specified unit.
 - c. Full size samples if requested.
 - 1) Field Engineer reserves right to retain sample until physical units are installed on project for comparison purposes.
 - 2) Requester pay all costs of furnishing and return of samples.
 - 3) Field Engineer is not responsible for loss of, or damage to, samples.
 - d. Name, address and phone numbers of at least 5 similar projects and name and phone number of Owner's representative that Field Engineer can contact; to discuss product, installation, and field performance data.
 - e. Itemized comparison of the propose substitution with product specified; list significant variations.
 - f. Data relating to changes in construction schedule.
 - g. Any effect of substitution on separate contracts.
 - h. List of changes required in other work or products.
 - i. Accurate cost data comparing proposed substitution with product specified.
 - j. Amount of net change to Contract Sum.
 - k. Designation of availability of maintenance services, sources of replacement materials.
 - 8. In making request for substitution, Contractor and suppliers represent:

- a. Has personally investigated proposed product or method, and have determined that it is equal or superior in all respects to that specified, and that it will perform intended function.
- b. Will provide same or better warranty for substitute item as for product or method specified.
- c. Will coordinate installation of accepted substitution into Work, to include building modifications if necessary, making such changes as may be required for Work to be complete in all respects.
- d. Certify cost data presented is complete and includes all related cost except any redesign cost of Owner's Representative.
- e. Waive all claims for additional costs or time related to substitution which subsequently become apparent or caused by substitution.
- f. Will pay all Owner's Representative redesign cost and other costs caused by substitution.
- g. Proposed substitution is in full compliance with applicable code requirements.
- h. Acknowledge acceptance of these provisions in request.
- 9. Substitute products shall not be ordered or installed without written acceptance of Owner's Representative and Owner.
- 10. Owner's Representative will recommend acceptability of proposed substitutions.
- D. Owner's Representative Duties:
 - 1. Review Contractor's request for substitutions with reasonable promptness.
 - 2. Recommend to Owner acceptance or rejection of request.
 - 3. Notify Contractor, in writing, of decision to accept or reject requested substitution.

1.6 REJECTION OF SUBSTITUIONS

- A. Substitutions will not be considered for acceptance when:
 - 1. They are indicated or implied on shop drawings or product data submittals without a formal request from Contractor.
 - 2. They are requested directly by a subcontractor or supplier.
 - 3. Acceptance will require substantial revision of Contract Documents.
 - 4. They are not submitted in accord with this document.
 - 5. Acceptance will require substantial revision of Contract Documents, or building spaces.
 - 6. Request for substitution does not indicate specific item for which request is submitted.
 - 7. Request form is not properly executed.
 - 8. Acceptance of manufacturer only will not be made.
 - 9. Insufficient information submitted.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 30 calendar days prior to time required for preparation and review of related submittals.
 - 1. Substitutions for Cause will only be considered in the case of product unavailability or other conditions beyond the control of Contractor.

- 2. Conditions: Owner's Representative will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Owner's Representative 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: Owner's Representative will consider requests for substitution for convenience if received **10 calendar days prior to bidding**. Substitutions for Convenience will only be received prior to bidding. Requests received after that time will not be considered.
 - 1. Conditions: Owner's Representative will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Owner's Representative will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Owner's Representative for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

SUBSTITUTION REQUEST PROJECT: PROJECT NUMBER: TO: BKL, Inc. 1623 E. 6th, Street Tulsa, Oklahoma 74120 Attn: Jenni Hammock FROM: ABOVE FIRM HEREBY REQUESTS CONSIDERATION OF FOLLOWING PRODUCT OR SYSTEMS AS A SUBSTITUTION IN ACCORD WITH PROVISIONS OF CONTRACT DOCUMENTS. SPECIFIED PRODUCT OR SYSTEM: Substitution request for: Specification Section Number: Article(s)/Paragraph(s): SUPPORTING DATA: Attach product description, specifications, drawings, photographs, performance data, test data, and any additional data or information for evaluation of the proposed substitution in accord with requirements of Document 00440. Yes: No: Yes: No: Sample is attached: Sample will be sent if requested: COMPARISON: SPECIFIED PRODUCT PROPOSED SUBSTITUTION Name, brand: _____ Catalog No.: _____ Manufacturer: Variations: ______ Maintenance Service Available: Yes: _____ No: _____ If yes, location: Spare Parts Source: _____

List minimum of 5 previous installations giving data regarding projects on which proposed substitution was used:

Project: Address: Owner's Representa- tive: Owner, address, tel: General Contractor: Date Installed: Dollar Value this Work:	
Project: Address: Owner's Representa- tive: Owner, address, tel: General Contractor: Date Installed: Dollar Value this Work:	
Project: Address: Owner's Representa- tive: Owner, address, tel: General Contractor: Date Installed: Dollar Value this Work:	
Project: Address: Owner's Representa- tive: Owner, address, tel: General Contractor: Date Installed: Dollar Value this Work:	
Project: Address: Owner's Representa- tive: Owner, address, tel: General Contractor: Date Installed: Dollar Value this Work:	

REASON FOR NOT GIVING PRIORITY TO SPECIFIED ITEMS:

EFFECT OF SUBSTITUTION:

(If yes, explain)	rical Work:
Substitution requires dimensional revision or redesign of structure or Mechanical and Electr Yes No (If yes, explain) STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENTS:	rical Work:
Yes No (If yes, explain) STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENTS:	
STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENTS:	
	Г
I/we have personally investigated the proposed substitution and determined that it is equal of in all respects to specified product or system and will perform intended function, except as a above; Will provide same warranty as specified; is in full compliance with applicable code requirements; have included complete cost data and implications of substitution; will pay redesign, special inspection and other costs caused by use of this substitution; will pay additional costs to other contractors caused by substitution; will coordinate incorporation of proposed substitution in Work; will modify other parts of Work as may be needed, to make all parts of Work complete and ing; waive future claims for added cost or time to Contract caused by substitution.	or superior stated function-
Acknowledgment:	
Address: Date: By: Position:	

END OF SUBSTITUTION REQUEST

END OF SECTION

SECTION 013300

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

1.2 DESCRIPTION

- A. See General Conditions and Supplementary Conditions for additional requirements.
- B. General Contractor or Subcontractors may require submittals for coordination purposes even if not required by Contract Documents for review.
- C. Submittals which are not required by Contract Documents may be returned to Contractor without review or action by Owner's Representative.

1.3 DEFINITIONS

- A. Shop Drawing submittals are drawings to scale, diagrams, schedules and other data specially prepared for Work by Contractor or a Subcontractor, sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of Work.
- B. Product Data submittals are illustrations, standard schedules, performance charts, instructions, brochures, color charts, performance curves, diagrams, test data and other information furnished by Contractor to illustrate material, product, equipment or system for some portion of Work.
- C. Project Information submittals are items pertaining to quality control and Owner information which do not require review or response by Owner's Representative and are to be retained for project file only.
 - 1. Examples include but are not limited to:
 - a. Product performance and construction test reports.
 - b. Certifications.
 - c. Design calculations.
 - d. Coordination drawings.
- D. Contract Closeout Information submittals are items pertaining to quality control and Owner information, which are required at Substantial or Final Completion, and do not require review or response by Owner's Representative.
 - 1. Examples:

- a. Pre-occupancy test reports.
- b. Warranties.
- c. Operation and maintenance data.
- d. Owner instruction reports.
- E. Shop Drawings, Product Data, Samples, Project Information and similar submittals are not Contract Documents.
 - 1. Purpose of submittal is to demonstrate for those portions of Work, for which submittals are required, the way Contractor proposed to conform to information given and design concept expressed in Contract Documents.
- F. "Base" manufacturer:
 - 1. Manufacturer listed as "Base" in Part 2 of specification section.
 - 2. Manufacturer listed as "Base" is the particular manufacturer of a specific product used as the basis of design.
- G. "Optional" manufacturer:
 - 1. Manufacturer listed as "Optional" in Part 2 of specification section.
 - 2. More than one manufacturer may be listed as "Optional".
 - 3. Manufacturers listed as "Optional" are particular manufacturers of products similar to the specific product used as the basis of design.
 - 4. Listing of manufacturer as "Optional" indicates acceptance of that manufacturer as supplier of the product, but only if that product complies with the specified requirements, including the salient qualities provided by "Base" manufacturer's product.
 - 5. Salient qualities include but are not necessarily limited to following:
 - a. Purpose and function.
 - b. Material and finish.
 - c. Strength, durability and other applicable physical properties.
 - d. Compatibility and performance attributes for indicated application.
 - e. Capacity and operating characteristics, where applicable.
 - f. Size and configuration to extent required for fit with adjoining and adjacent conditions and within spatial limitations.
 - g. Appearance, including exposed dimensions, profile, texture, pattern and color, where visible to personnel in a finished space or from exterior.
 - 6. Contractor is responsible for costs to provide any, dimensional, operational, structural, or utility or other related adjustments to fit an "Optional" manufacturer's product into the Work.
- H. Action Submittals: Written and graphic information and physical samples that require Owner's Representative's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- I. Informational Submittals: Written and graphic information and physical samples that do not require Owner's Representative's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Owner's Representative and additional time for handling and reviewing submittals required by those corrections.

1.5 TRANSMITTAL - GENERAL

- A. Contractor is responsible for making submissions.
 - 1. Submit to address indicated.
 - 2. Submittal shall include items from one specification section only.
 - 3. Transmit items with Submittal Transmittal form included in this Section or supplied by Owner's Representative.
 - 4. Contact Owner's Representative for copy made for Project.
 - 5. Submittal Number.
 - 6. Indicate Project name, description of submitted items or systems and manufacturer.
 - 7. Indicate approval and sign in appropriate space.

1.6 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Owner's Representative.
 - 4. Name of Contractor.
 - 5. Name of firm or entity that prepared submittal.
 - 6. Names of subcontractor, manufacturer, and supplier.
 - 7. Unique submittal number, including revision identifier.
 - a. Identify each submittal using applicable 6 digit specification Section number.
 - b. After Section number indicate sequence number, e.g., first submittal of Section 033450 series would be numbered "033450-1", next would be "033450-2", etc.
 - c. If returned for re-submission, add a designation character, e.g., second submission would be "03450-1A", third would be "03450-1B".
 - 8. Category and type of submittal.
 - 9. Submittal purpose and description.
 - 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 - 11. Drawing number and detail references, as appropriate.
 - 12. Indication of full or partial submittal.
 - 13. Location(s) where product is to be installed, as appropriate.
 - 14. Other necessary identification.
 - 15. Remarks.
 - 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Owner's Representative.

- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Owner's Representative on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Paper Submittals:
 - 1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
 - 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Owner's Representative.
 - 3. Action Submittals: Submit one paper copy of each submittal unless otherwise indicated. Owner's Representative will return one copy.
 - 4. Informational Submittals: Submit one paper copies of each submittal unless otherwise indicated. Owner's Representative will not return copies.
- E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.7 SUBMITTAL PROCEDURES

- A. Provide information required for complete review of each item in one submittal.
- B. Do not highlight pertinent information with markings that turn opaque or will not scan or reproduce on electrostatic copies.
- C. Do not submit information on a portion of a submittal.
- D. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
- E. Email: Prepare submittals as PDF package, and transmit to Owner's Representative by sending via email. Include PDF transmittal form. Include the following information in email subject line.
 - a. Project Name and Number
 - b. Number and title of Specification Section
 - 2. Paper: Prepare submittals in paper form, and deliver to Owner's Representative.
- F. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- G. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Owner's Representative'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. Owner's Representative will advise Contractor when a submittal being processed must be delayed for coordination.
- 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- I. 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.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Owner's Representative's action stamp.

1.8 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. 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 Owner's Representative's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Title block indicating; Project name, Project number, drawing number, and name of entity preparing submittal.

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- b. Allow clear space, approximately 40 SQ IN, for Contractor's approval stamp and Owner's Representative action stamp on right hand side.
- c. Comply with Owner's requirements and office policy.
- d. Identification of products.
- e. Schedules.
- f. Compliance with specified standards.
- g. Notation of coordination requirements.
- h. Notation of dimensions established by field measurement.
- i. Relationship and attachment to adjoining construction clearly indicated.
- j. Seal and signature of professional engineer if specified.
- k. 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 22 by 34 inches.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Paper Transmittal: Include paper transmittal with the sample including complete submittal information indicated.
 - 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Printed colors and color copies are only acceptable to selecting a range of actual samples to be submit for selection.
 - b. Printed colors and color copies are not acceptable for final selection.
 - c. Number of Samples: Submit one full set or selected range of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line.
 - d. Owner's Representative will return the PDF submittal with options selected. The samples will only be return when requested by Contractor. If samples are requested to be return by

the Contractor the samples will only be returned after the project record sample has been received.

- e. Once the sample has been selected submit 3 sets of the selected Sample(s) as a project record Samples. The Owner's Representative will retain one Sample sets; remainder will be returned.
- 7. 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. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Owner's Representative will retain one Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) 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.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 - 1. Provide Certificates Provide Test Reports if indicated in individual Specification.
 - 2. Certificates and Certifications Submittals: Submit 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. Provide a notarized signature where indicated.
 - 3. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

- 4. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- 5. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- 6. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- 7. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
 - 1. Provide Test Reports if indicated in individual Specification.
 - 2. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
 - 3. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 - 4. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 - 5. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
 - 6. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
 - 7. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.9 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 insufficient to perform services or certification required, submit a written request for additional information to Owner's Representative.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file 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.

1.10 **PROJECT INFORMATION AND CONTRACT CLOSEOUT INFORMATION**

- A. Project Information submittals are required as called for by specification section submittal paragraph.
- B. Submit three (3) original or high quality, high contrast copy of each submittal, unless quantity is indicated elsewhere.
 - 1. Include pertinent data.
 - 2. Submit in envelope.
 - 3. Do not fold.
 - 4. Submit 8-1/2 x 11 IN or 8-1/2 x 14 IN maximum copy.
- C. Project Information:
 - 1. Owner's Representative may review submittal at its sole discretion, for general compliance with Contract Documents only.
 - 2. Review will not constitute a detailed check of submitted design calculations.
 - 3. Appropriateness and accuracy of calculations is responsibility of Contractor (and Contractor's professional engineer when such calculations are required to be professionally sealed).
 - 4. When professional or other certification of performance criteria of materials, systems or equipment is required by Contract Documents, Owner's Representative shall be entitled to rely upon accuracy and completeness of such calculations and certifications.
- D. Contract Closeout Information:
 - 1. Owner's Representative may review submittal at its sole discretion, for general compliance with Contract Documents only.

1.11 CONTRACTOR AND SUBCONTRACTOR REVIEW / ACTION

- A. Action Submittals 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 Owner's Representative.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include 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.

- 1. Owner's Representative will not review submittals received from Contractor that do not have Contractor's review and approval.
- C. Direct specific attention, in writing or on Shop Drawings, Product Data, Samples or similar submittals, to deviations from requirements of Contract Documents.
 - Contractor shall not be relieved of responsibility for any deviation from requirements of Contract Documents by Owner Representative's approval of Shop Drawings, Product Data, Samples or similar submittal unless Contractor has specifically informed Owner's Representative in writing of such deviation at time of submission and (1) Owner's Representative has given written approval to specific deviation as a minor change in Work, or (2) a Change Order or Construction Change Directive has authorized the deviation.
 - 2. Completed work shall match appearance of approved samples and mock-ups.
- D. Contractor represents and warrants that submittals shall be prepared by persons and entities possessing expertise and experience in the trade for which the submittal is prepared and, if required by Owner's Representative or applicable law, by a licensed professional engineer.
- E. Contractor is responsible for confirmation and correlation of dimensions at job site; for information that pertains solely to fabrication processes or to techniques of construction; and for coordination of work of trades.
- F. Contractor and Subcontractor review for compliance with Contract Documents, approve and submit submittal required by Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in activities of Owner or of separate contractors.
- G. Each submittal shall bear Contractor's approval stamp, indicating "(contractor's name) REVIEWED FOR COMPLIANCE WITH THE CONTRACT DOCUMENTS AND APPROVED", and validated with signature of a Contractor's authorized representative
- H. Submittal transmittal to Owner's Representative indicates Contractor, Subcontractor and subsubcontractor represents that they have:
 - 1. Reviewed for compliance with the Contract Documents.
 - 2. Determined and verified materials, field measurements and quantities related thereto.
 - 3. Determined and verified field construction criteria, materials, performance criteria, installation requirements, catalog numbers and similar data related thereto.
 - 4. Checked, determined, verified and coordinated information contained within such submittals with requirements of Work, Contract Documents and other submittals.
 - 5. Certified that submittal is in compliance with Contract Documents.
 - 6. Approved submittal.
- I. Resubmit items stamped "Revise and Resubmit" or "Not Approved" until approval is received.
 - 1. Direct specific attention, in writing, on resubmitted Shop Drawings, Product Data or Samples, to revisions other than those requested by Owner's Representative on previous submittals.
- J. Contractor reproduce and distribute submittals after Owner's Representative's review:
 - 1. Subcontractor/vendor.
 - 2. Other Contractors, Subcontractors or vendors as may be required for coordination purposes.

- K. Contractor shall not be relieved from responsibility for coordination with other submittals or for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by Owner's Representative's approval thereof.
- L. Where a submittal is required by the Specifications, any related Work performed prior to Owner's Representative's review and approval of the pertinent submission will be the sole expense and responsibility of Contractor.

1.12 OWNER'S REPRESENTATIVE'S REVIEW: SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- A. Action Submittals: Owner's Representative will review each submittal, indicate corrections or revisions required, and return it.
 - 1. PDF Submittals: Owner's Representative will indicate, via markup on each submittal, the appropriate action.
 - 2. Paper Submittals: Owner's Representative will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Owner's Representative will review each submittal and will not return it, or will return it if it does not comply with requirements. Owner's Representative will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Owner's Representative.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Owner's Representative will return without review submittals received from sources other than Contractor.
- F. Review is only for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- G. Such review and action is limited to only those submittals identified in Contract Documents.
- H. Owner's Representative's review of such submittals is not conducted for purpose of determining accuracy and completeness of other details such as dimensions, quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor.
- I. Owner's Representative will stamp required submittals indicating action taken.
- J. Owner's Representative's review or approval shall not constitute a review of safety or health precautions or, of any construction means, methods, techniques, sequences or procedures.
- K. Owner's Representative's review or approval of a specific item shall not indicate approval of an assembly of which item is a component.

- L. Owner's Representative's obligation to review or approve submittals and to return them with reasonable promptness are conditional upon prior review and approval of submittals by Contractor and Contractor's transmittal of submittals in accordance with Contract Documents and approved Schedule of Submittals.
- M. Items not submitted in accordance with provisions of this section may be returned, without action.
- N. Submittals which are not required by Contract Documents, or submittals which have not been approved and signed by Contractor may be returned by Owner's Representative without review or action.
- O. If a submittal must be delayed for coordination with other submittals not yet submitted, the Owner's Representative may at his option either return the submittal with no action or notify the Contractor of the other submittals which must be received before the submittal can be reviewed.
- P. Owner's Representative will return original copy of submittal indicating comments and action for Contractor's use and distribution. Additional submitted copies may not be returned.
- Q. The Submittals may returned by email or regular mail.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 014000 QUALITY REQUIREMENTS (TEST AND INSPECTIONS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other qualityassurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Owner's Representative, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described 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.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. 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, assembly, 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).
- D. 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.
- E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency

qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

- F. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Owner's Representative.

1.3 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements 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 Owner's Representative for direction 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 Owner's Representative for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
C. Permits, Licenses, and Certificates: For Owner's record, 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 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Statement on condition of substrates and their acceptability for installation of product.
 - 2. Statement that products at Project site comply with requirements.
 - 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Statement that equipment complies with requirements.
 - 2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 3. Other required items indicated in individual Specification Sections.

1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Qualifications of independent testing agencies:
 - 1. Meet American Council of Independent Laboratories, "Recommended Requirements of Independent Laboratory Qualification" latest edition.
 - 2. Meet requirements of ASTM-E329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as used in Construction", latest edition.
 - 3. Satisfy inspection criteria of Materials Reference Laboratory of National Bureau of Standards.
 - 4. Owner approval of Testing agency is required.
- C. Testing equipment calibration: By accredited calibration agency, at maximum 12 month intervals, by devices of accuracy traceable to either:
 - 1. National Institute of Standards and Technology.
 - 2. Accepted values of natural physical constants.
- D. Manufacturer Qualifications:
 - 1. A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- E. Fabricator Qualifications:
 - 1. 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.
- F. Installer Qualifications:
 - 1. A firm or individual experienced in installing, erecting, applying, 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.
 - 2. Installer trained and approved by manufacturer, acceptable to manufacturer, or an authorized representative of manufacturer for both installation and maintenance. If other design professionals are indicated in Specification Sections, insert qualifications here.
- G. Professional Engineer Qualifications:
 - 1. 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.
- H. Specialists:
 - 1. Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

- 2. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- I. Testing Agency Qualifications:
 - 1. An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection 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.
- J. Manufacturer's Technical Representative Qualifications:
 - 1. 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.
- K. Factory-Authorized Service Representative Qualifications:
 - 1. An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- L. Preconstruction Testing:
 - 1. Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 2. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - d. When testing is complete, remove test specimens and test assemblies, and mockups, and laboratory mockups; do not reuse products on Project.
 - 3. Testing Agency Responsibilities:
 - a. Submit a certified written report of each test, inspection, and similar quality-assurance service to Owner's Representative, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 - 2. Testing will be paid for by owner except as noted under Contractor Responsibilities.

- B. Contractor Responsibilities:
 - 1. Provide for any additional inspection and testing required by public authorities having jurisdiction.
 - 2. Employment of independent testing agency approved by Owner does not relieve the Contractor's obligation to comply with Contract Documents.
 - 3. Cooperate with testing agency personnel; provide access to the work and to manufacturer's operations.
 - 4. Provide preliminary representative samples of materials to be tested, in required quantities.
 - 5. Furnish labor and facilities:
 - a. To provide access to work to be tested.
 - b. To obtain and handle samples at site.
 - c. To facilitate inspections and tests.
 - 6. Storage and curing facilities for testing agency's exclusive use.
 - 7. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 - 8. Contractor will arrange and pay for following testing and inspections:
 - a. Re-testing of any required tests.
 - b. Testing of non-conforming work.
 - c. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents.
 - 9. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 10. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 - 11. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 12. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 13. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting:
 - 1. 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.
- D. Testing Agency Responsibilities:
 - 1. Provide qualified personnel promptly on notice.
 - 2. Cooperate with Owner's Representative and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 3. Notify Owner's Representative and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 4. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.

- 5. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
- 6. Submit a certified written report, in duplicate, of each test, inspection, and similar qualitycontrol service through Contractor.
- 7. Testing agency is not authorized to:
 - a. Release, revoke, alter, or increase the Contract Document requirements.
 - b. Approve or accept any portion of the Work.
 - c. Perform duties of Contractor.
- E. Manufacturer's Field Services:
 - 1. Where indicated, engage a factory-authorized service representative to inspect fieldassembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services:
 - 1. Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Associated Contractor Services:
 - 1. Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 2. Access to the Work.
 - 3. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 4. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 - 5. Facilities for storage and field curing of test samples.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination:
 - 1. Coordinate sequence of activities to accommodate required quality-assurance and qualitycontrol services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
 - 2. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

3.2 PERFORMANCE

- A. Perform indicated inspections, sampling and testing of materials and methods of construction.
- B. Use test/inspection/sampling methods conforming with methods indicated.
- C. Report each test/inspection/sampling as indicated.
- D. Report results called for by test method, in form specified.
- E. Retest failed products and systems.

3.3 REPORTS

- A. Submit reports and logs promptly to Owner's Representative.
 - 1. Reports shall be in both paper and electronic format.
- B. Include for test/inspection reports:
 - 1. Project name and number.
 - 2. Project location.
 - 3. Product and specification section applicable.
 - 4. Type of test/inspection.
 - 5. Name of testing agency (if used).
 - 6. Name of testing/inspecting personnel.
 - 7. Date of test/inspection.
 - 8. Record of field conditions encountered (temperature, weather).
 - 9. Test location.
 - 10. Observations regarding compliance.
 - 11. Test method used.
 - 12. Results of test.
 - 13. Date of report.
 - 14. Signature of testing/inspecting personnel.
 - 15. Date test or inspection results were transmitted to Owner's Representative.

C. Maintain log of tests which have failed:

- 1. Type of test/inspection.
- 2. Date of test/inspection.
- 3. Test/inspection number.
- 4. Reason failed.
- 5. Date of retest/inspection.
- 6. Results of retest.

- 7. Method of retest.
- D. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Owner's Representative's reference during normal working hours.
 - 1. Submit log at Project closeout as part of Project Record Documents.

3.4 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 015000 TEMPORARY FACILITIES AND CONTROLS (CONSTRUCTION FACILITIES, TEMPORARY CONTROLS AND UTILITIES)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 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 engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Owner's Representative, testing agencies, and authorities having jurisdiction. Contractor shall be responsible for providing connection and extensions.
- 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel. Contractor shall be responsible for providing connection and extensions.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.

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.
- C. Accessible Temporary Egress: Comply with applicable provisions in [the United States Access Board's ADA-ABA Accessibility Guidelines] [and] [ICC/ANSI A117.1].
- D. Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to following:
 - 1. Building code requirements.
 - 2. Health and safety regulations.
 - 3. Utility company regulations.
 - 4. Police, fire department, and rescue squad rules.
 - 5. Environmental protection regulations.
 - 6. Local agencies requirements and regulations.
- E. Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Contractor shall obtain required certifications and permits for temporary utilities, and shall include in his base bid all fees, labor and materials for necessary services.
- F. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of Work. Relocate and modify facilities as required.

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.

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.

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: Provide vented, self-contained, liquid-propane-gas or electric heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
- B. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 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.
- 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.

3.3 TEMPORARY UTILITY

- A. General
 - 1. All fees, labor, and materials, including temporary equipment and connection thereof, required to provide temporary utility services necessary for maintaining existing services and for execution of work, and tests required in various sections of specifications shall be furnished by contractor at contractor's expense, except where otherwise specified.
 - 2. Maintain and keep temporary services and facilities clean and neat in appearance, including those provided by owner for contractor's use. Operate in a safe and efficient manner. Coordinate with City of Tulsa representative to relocate temporary services and facilities as work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.
 - 3. Prepare a schedule indicating dates for implementation, shut downs, tie-ins and termination of each temporary utility and coordinate with City of Tulsa representative. At earliest feasible time, when acceptable to City of Tulsa representative, change over from use of temporary service to use of permanent service.
 - 4. Remove all temporary equipment and connections, and leave premises and existing permanent apparatus in an equivalent condition as existed prior to making temporary connections.

B. Temporary Electrical And Lighting

- 1. General: install temporary service or connect to existing service.
- 2. Arrange with utility company, owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- 3. Electric power service:
 - a. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - b. Install electric power service overhead unless otherwise indicated.
 - c. Make arrangements for and install all equipment, poles, meter, wiring, switches, outlets, etc., to provide 480v, 3 phase power and necessary step down transformers for 208v and 120v power for all lighting and power requirements for construction purposes.
 - d. Temporary electrical power used will be paid for by contractor.
 - e. Remove all temporary electrical equipment, when no longer needed.
- 4. Lighting:
 - a. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - b. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - c. Provide adequate lighting with local switching for safe access and egress, security, and for providing adequate illumination for construction operations.
- 5. At completion of work, remove and replace all damaged parts of permanent systems.
- 6. Extend warranty or guarantee period on permanent systems used during construction period so they commence on date of substantial completion.
- 7. Each contractor provide his own extension cords.
- 8. Each contractor provide any additional electrical power required for his operation, exceeding available power.
- C. Sewers And Drainage:
 - 1. Provide temporary utilities to remove effluent lawfully.
 - 2. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- D. Temporary Water Service:
 - 1. Make all arrangements, install equipment, piping, and outlets for an adequate supply of clean water for construction purposes. Install water service and distribution piping in sizes and pressures adequate for construction.
 - a. Existing water distribution system may be used for temporary service.
 - b. Provide temporary meters and pay costs of installation and use.
 - c. Provide pressure backflow preventer at each connection.
 - 2. Contractor pay for all water used.
 - 3. Furnish drinking water and paper cups for all those connected with the work.
- E. Sanitary Facilities:
 - 1. Provide temporary toilets, wash facilities, and drinking water for use of construction personnel.

- 2. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- 3. Maintain and service in clean, sanitary condition.
- 4. Provide adequate supplies of toilet paper, cleaning and other required items.
- F. Temporary heating and cooling:
 - 1. 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.
 - 2. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 3. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- G. Isolation of work areas in occupied facilities:
 - 1. Prevent dust, fumes, and odors from entering occupied areas.
 - 2. Provide temporary telephone service in common-use facilities for use by all construction personnel.
 - 3. Provide a desktop computer in the primary field office adequate for use by Owner's Representative and owner to access project electronic documents and maintain electronic communications. Equip computer with not less than the following:
 - 4. Full-size keyboard and mouse.
 - 5. Operating system: microsoft windows 10 professional.
 - 6. Productivity software:
 - a. Microsoft office professional, 2010 or higher, including word, excel, and outlook.
 - b. Adobe reader 11.0 or higher.
 - c. Winzip 7.0 or higher.
 - 7. Printer: "all-in-one" unit equipped with printer server, combining printing, photocopying, scanning, and faxing, or separate units for each of these functions.

3.4 TEMPORARY STORAGE AND STAGING AREAS

- A. Prior to start of work, Contractor shall meet with all Subcontractors to arrange and prepare plot plan defining staging, storage, field office and traffic areas.
- B. Obtain City of Tulsa representative approval of plan.
- C. Except as specifically provided, working and storing outside these areas will not be permitted.
- D. Arrange and locate temporary structures and storage to avoid interfering with construction.
- E. Within area designated for his use, Contractor and Subcontractors provide suitable and sufficient enclosed and covered spaces, with raised flooring, to protect materials and equipment from damage by weather or construction work.
- F. Maintain storage and working areas in clean and orderly condition.

3.5 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Maintain support facilities until Owner's Representative 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. Traffic Controls:
 - 1. Comply with requirements of authorities having jurisdiction.
 - 2. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 3. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking:
 - 1. Contractor shall provide parking areas for construction personnel within the area designated "Staging" on drawings.
- D. Dewatering Facilities and Drains:
 - 1. Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 2. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 3. Remove snow and ice as required to minimize accumulations.
- E. Waste Disposal Facilities:

Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

- F. Lifts and Hoists:
 - 1. Provide facilities necessary for hoisting materials and personnel.
 - 2. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.6 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Temporary access
 - 1. Contractor's access to construction area will be permitted only through designated approaches in such a manner that traffic will not interfere with owner's activities.
- B. Temporary protection
 - 1. Protect work in progress and adjoining materials in place, during handling and installation.
 - 2. Supervise construction operation to assure that work, completed or in progress, is not subject to harmful, dangerous, damaging or otherwise deleterious exposure throughout construction period.
 - 3. Apply protective covering to assure protection of work from damage or deterioration. Remove coverings at substantial completion.
 - 4. Adjust, lubricate and maintain operable components to assure operability without damaging effects throughout construction period.

- C. Temporary access roads
 - 1. Clean up all debris, materials, etc., that fall from vehicles en route to and from site.
 - 2. Do not block access to adjacent facilities.
- D. Traffic control
 - 1. Provide any traffic control deemed necessary to effect smooth owner operations.
 - 2. Provide and maintain adequate traffic control and flagmen's services at all points where transporting of equipment and materials engaged on work enters and exits from project site and on site.
- E. Protection of existing facilities:
 - 1. 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.
 - 2. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- F. Environmental protection:
 - 1. 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.
- G. Temporary erosion and sedimentation control:
 - 1. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA construction general permit or authorities having jurisdiction, whichever is more stringent.
 - 2. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 3. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 4. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from project site during the course of project.
 - 5. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- H. Stormwater control:
 - 1. 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.
- I. Tree and plant protection:
 - 1. Protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- J. Temporary fences and barricades:
 - 1. Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

- 2. Contractor furnish, install and maintain all necessary sound temporary fences, barricades, trench and hole covers, warning lights and all other safety devices necessary to prevent injury to persons and damage to property and trees.
- 3. Contractor is responsible to design all construction barricades and fences with proper sizes of members and with adequate supports to protect public from injuries or accidents, arising from construction work.
- 4. Extent of fence: as required to enclose portion of work determined sufficient to accommodate construction operations.
- 5. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to owner.
- 6. Warning signs, and lights:
 - a. Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- K. Temporary enclosures:
 - 1. 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.
 - 2. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary fire protection:
 - 1. 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.
 - 2. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other sections.
 - 3. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 4. Develop and supervise an overall fire-prevention and -protection program for personnel at project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.7 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 - 3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

- 1. Protect porous materials from water damage.
- 2. Protect stored and installed material from flowing or standing water.
- 3. Keep porous and organic materials from coming into prolonged contact with concrete.
- 4. Remove standing water from decks.
- 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard and replace stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.8 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. 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. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION

SECTION 016000 PRODUCT REQUIREMENTS (DELIVERY, HANDLING AND STORAGE: MATERIAL AND EQUIPMENT)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 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.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Owner's Representative 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.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.

- 2. Owner's Representative's Action: If necessary, Owner's Representative will request additional information or documentation for evaluation within reasonable number of days of receipt of a comparable product request. Owner's Representative will notify Contractor of approval or rejection of proposed comparable product request within a reasonable number of days of receipt of request, or receipt of additional information or documentation, whichever is later.
 - a. Form of Owner's Representative's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 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.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. JOB CONDITIONS

- 1. Comply with applicable codes.
- 2. Accomplish work to avoid damage to property.
- 3. Provide fire protection.
- B. 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.
- C. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Schedule deliveries to avoid delaying Work.
 - 3. Schedule and coordinate deliveries to avoid interference with Owner's operation.
 - 4. The contractor is responsible for acceptance at site.
 - 5. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 6. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Where applicable, with UL labeling on packages.
 - 7. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected. Reorder as required to avoid delays.
 - 8. Deliver products to Project site by manufacturer's normal means.

D. Storage:

- 1. Store products to allow for inspection and measurement of quantity or counting of units.
- 2. Store materials in a manner that will not endanger Project structure.
- 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
- 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
- 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- 6. Protect stored products from damage and liquids from freezing.
- 7. Protect weather fragile items from weather damage.
- 8. Handle and store bulk aggregates to avoid contamination.
- 9. Store to allow air circulation.
- 10. Store only in authorized areas.
- 11. Coordinate on site storage with Field Engineer and other contractors working on site.
- 12. Replace or repair damaged items.
- 13. Uncrate, assemble, if required, and remove debris.
- 14. When off-site storage is utilized, perform rehandling to move items to site at no added cost.
- E. Cleanup
 - 1. Remove excess materials from site.
 - 2. Turn over to city of Tulsa Field Engineer, excess materials scheduled to remain.
 - Clean debris from site and storage area. Restore site storage areas to original condition or as directed by Field Engineer

1.6 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. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Owner's Representative will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
 - 1. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
 - 2. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
 - 3. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
 - 4. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.

- a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
- 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Owner's Representative's sample," provide a product that complies with requirements and matches Owner's Representative's sample. Owner's Representative's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Owner's Representative from manufacturer's full range" or similar phrase, select a product that complies with requirements. Owner's Representative will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Owner's Representative will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Owner's Representative may return requests without action, except to record noncompliance with these requirements:
 - 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 - 2. Evidence that proposed product provides specified warranty.
 - 3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - 4. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 017300

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 OPERATION AND MAINTENANCE DATA AND MANUALS

- A. Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment Supplier shall prepare a project specific operation and maintenance manual for each type of equipment indicated in the individual equipment sections or the equipment schedule.
- B. Parts lists and operating and maintenance instructions shall be furnished for other equipment not listed in the individual equipment sections or the equipment schedule.
- C. Operation and maintenance manuals shall include the following:
 - 1. Equipment function, normal operating characteristics, and limiting conditions.
 - 2. Assembly, installation, alignment, adjustment, and checking instructions.
 - 3. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
 - 4. Lubrication and maintenance instructions.
 - 5. Guide to troubleshooting.
 - 6. Parts lists and predicted life of parts subject to wear.
 - 7. Outline, cross section, and assembly drawings; engineering data; and wiring diagrams.
 - 8. Test data and performance curves, where applicable.
- D. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Contractor.
- E. Three hard copies of each manual shall be submitted to Engineer prior to the date of shipment of the equipment. When the O&M manuals are returned with the review status "RETURNED FOR CORRECTION", the corrections shall be made as instructed by the Engineer , and two copies of the corrected portion(s) and one complete corrected copy of the O&M manual returned to the Engineer . After review by Engineer, is complete one hard copy and one electronic copy of each operation and maintenance manual shall be prepared and delivered to Engineer not later than 30 days prior to placing the equipment in operation. The electronic copy will be reviewed for content and organization and assigned a review status by the Engineer. When corrections are required, a corrected version of the electronic copy shall be resubmitted. Procedures for submission of the electronic copy will be provided after award of the Contract. When review of the electronic copy by the Engineer is complete, three copies of each electronic O&M manual

shall be delivered on CD-ROM to the Engineer. Each CD shall contain only one copy of one manual.

- F. The "O&M and Nameplate Information for Equipment ID" Form must be included with each O&M Manual for each piece of equipment valued at more than \$1,000. The Equipment ID Form shall be submitted by the Contractor for all equipment provided with a value more than \$1,000 irrespective of whether an O&M manual is provided; that requires preventative maintenance to be performed; any valve 8 inches or larger; and all motorized valves that are smaller than 8 inches that require preventative maintenance.
- G. Contractor shall complete the Project Close-Out Checklist spreadsheet as required for each item with an Antero form. An electronic version of the spreadsheet will be provided by Owner after contract is awarded.
- H. All material shall be marked with project identification, and inapplicable information shall be marked out or deleted.
- I. Shipment of equipment will not be considered complete until all required manuals and data have been received.

1.2 HARD COPY OPERATION AND MAINTENANCE MANUALS

A. Hard copies submitted for review shall be temporarily bound in heavy paper covers bearing suitable identification. All manuals and other data shall be printed on heavy, first quality 8-1/2 x 11 inch paper, with standard three-hole punching. Drawings and diagrams shall be reduced to 8-1/2 x 11 inches or 11 x 17 inches. Where reduction is not practicable, larger drawings shall be folded separately and placed in envelopes, which are bound into the manuals. Each envelope shall be suitably identified on the outside. Each volume containing data for three or more items of equipment shall include a table of contents and index tabs. The final hard copy of each manual shall be prepared and delivered in substantial, permanent, three-ring or three-post binders with a table of contents and suitable index tabs.

1.3 ELECTRONIC OPERATION AND MAINTENANCE MANUALS.

- A. Electronic manuals shall be in Adobe Acrobat's Portable Document Format (PDF), and shall be prepared at a resolution between 300 and 600 dots per inch (dpi), depending on document type. Optical Character Recognition (OCR) capture shall be performed on these documents. OCR settings shall be performed with the "original image with hidden text" option in Adobe Acrobat Exchange.
- B. File size shall be limited to 10 MB. When multiple files are required the least number of files possible shall be created. File names shall be in the format OMXXXXX-YYYZ-V.pdf, where Mohawk Water Treatment Plant Storage Facility TMUA-W 20-01

IMUA-W 20-01 April 15, 2021 017300 - 2 XXXXX is the five digit number corresponding to the specification section, YYY is a three digit O&M manual number, e.g. 001, Z is the letter signifying a resubmittal, A, B, C, etc, and V is a number used only when more than one 10 MB file is required for an O&M manual.

- C. Documents prepared in PDF format shall be processed as follows:
 - 1. Pages shall be searchable (processed for optical character recognition) and indexed when multiple files are required.
 - 2. Pages shall be rotated for viewing in proper orientation.
 - 3. A bookmark shall be provided in the navigation frame for each entry in the Table of Contents.
 - 4. Embedded thumbnails shall be generated for each completed PDF file.
 - 5. The opening view for PDF files shall be as follows:
 - 6. Initial View: Bookmarks and Page
 - 7. Page Number: Title Page (usually Page 1) Magnification: Set to Fit in Window
 - 8. Page: Single Page
 - 9. Where the bookmark structure is longer than one page the bookmarks shall be collapsed to show the chapter headings only.
 - 10. When multiple files are required the first file of the series (the parent file) shall list every major topic in the Table of Contents. The parent file shall also include minor headings bookmarked based on the Table of Contents. Major headings, whose content is contained in subsequent files (children) shall be linked to be called from the parent to the specific location in the child file. The child file shall contain bookmark entries for both major and minor headings contained in the child file. The first bookmark of any child file shall link back to the parent file and shall read as follows "Return to the *Equipment Name* Table of Contents", e.g. Return to the Polymer Feed System Table of Contents.
 - 11. Drawings shall be bookmarked individually.
 - 12. Files shall be delivered without security settings to permit editing, insertion and deletion of material to update the manual provided by the manufacturer.

1.4 LABELING

- A. As a minimum, the following information shall be included on all final O&M manual materials, including CD-ROM disks, jewel cases, and hard copy manuals:
 - 1. Equipment name and/or O&M title spelled out in complete words. Project Name.
 - 2. City Project/Contract Number.
 - 3. Specification Section Number. Example: "Section 15500" Manufacturer's name.
 - 4. File Name and Date.
- B. For example:
 - 1. Pump Mixing System Systems Operation and Maintenance Manual Somewhere Plant Expansion
 - 2. Project/Contract No. ____ Specification Section 11331 Manufacturer
 - 3. OM11331-001.pdf, 5/05/16

PART 2 - PRODUCTS

2.1 EQUIPMENT ID TAGs

2.2 General Requirements:

- A. The following items will require equipment ID number tags to be permanently installed.
 - 1. Any equipment valued over \$1,000
 - 2. All Valves greater than 8"
 - 3. All relief and motorized valves that are smaller than 8"
 - 4. Any equipment that requires preventive maintenance
 - 5. Any equipment that is critical to the process of the plant
 - 6. Any equipment that is considered a Safety item
 - a. Emergency Eyewash/Showers
 - b. Fire Extinguishers
 - c. All Ladders
 - d. Hoists
 - e. Detectors
 - f. Overhead Doors
 - g. Fire Alarms/Sprinklers
 - h. Emergency Lights

2.3 Tag material:

- A. Phenolic plastic tags
- B. Blue with White Engraving
- C. U/V stable
- D. Engraved to a depth of 0.08mm

2.4 Rectangle tags for Equipment:

- A. Plastic 3.5"x .75" tag 1/16" thick.
- B. 1 line of text, capitalized block letters, centered on tag "MOH-XXX-XXXXX"
- C. (Must follow equipment ID numbering scheme).
- D. Lettering .25" high
- E. Tags shall be attached to equipment with adhesive.

2.5 Round tags for Valves:

- A. Plastic 1.5" tags 1/16" thick
- B. 3 lines of text, capitalized block letters, centered on tag, "MOH-XXX-XXXX"
- C. (Must follow equipment ID numbering scheme).
- D. Lettering -3/16" high
- E. Tags shall be attached to equipment with stainless steel permanent ties.

PART 3 - EXECUTION

3.1 DATA REQUIRED FOR FINISH MATERIALS

- A. Maintenance data:
 - 1. Precautions necessary.
 - 2. Manufacturer's instructions and recommendations.
 - 3. Maintenance materials and tools required.
 - 4. Repair and/or replacement instructions.
 - 5. Name and address of manufacturer.
 - 6. Name and address of local supplier of materials.

END OF SECTION

O&M & NAMEPLATE INFORMATION EQUIPMENT I.D.

Equipment I.D. Number	
Description	
Project #	
Spec #	
Vendor	
Manufacturer	
Model #	
Serial #	
Purchase Price	
Date Placed in Service	
Parts Associated/details	
Maintenance Schedule	
If Applicable Motor Info	
Vendor	
Manufacturer	
Model #	
Serial #	

017300-A

SECTION 017700 CLOSEOUT PROCEDURES (CONTRACT CLOSEOUT AND CLEANING)

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.
 - 6. Final walkthrough and punch list.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.
- D. Final walkthrough and punch list.

1.3 CLOSEOUT SUBMITTALS

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

1.4 SUBMITTALS

A. Contract closeout information for substantial completion:

1. Comprehensive list of all items to be completed or corrected. Mohawk Water Treatment Plant Storage Facility TMUA-W 20-01 April 15, 2021 017700 - 1

- 2. Contractor's Notice of Substantial Completion.
- 3. Certificates of governing authorities.
- 4. Submittals required by other Sections.
- B. Contract closeout information for final completion:
 - 1. Contractor's Certificate of Completion.
 - 2. Evidence of payments and release or waiver of liens in triplicate.
 - a. Contractor's Affidavit of Payments of Debts and Claims: AIA Document G706.
 - b. Contractor's Affidavit of Release of Liens: AIA Document G706A.
 - c. Contractor's release or waiver of liens.
 - d. Separate releases or waivers of liens for subcontractors, suppliers, and others with lien rights against Owner, together with list of all such parties.
 - e. If required by Owner, other data establishing payment or satisfaction of obligations arising out of Contract.
 - 3. Consent of Surety to Final Payment: AIA Document G707.
 - 4. Certificates evidencing that insurance to remain enforce.
 - 5. Final application for payment.
 - 6. Initialed list(s) of items to be completed or corrected verifying completion of each items.
 - 7. List of Subcontractors and equipment suppliers. Include:
 - a. Name.
 - b. Address.
 - c. Telephone number.
 - d. Representative.
 - e. Closeout submittals required by other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Substantial Completion is the stage in the progress of Work when the Work or designated portion thereof is sufficiently complete in general accordance with Contract Documents so Owner can occupy or utilize Work for its intended use.
 - 1. Work will not be considered for Substantial Completion until all systems and equipment are operational; all designated or required governing agency inspections and certifications have been made and posted, instruction of designated Owner's personnel in operation of systems and equipment has been completed, operation and maintenance data has been satisfactorily turned over to Owner, and finishes are in place. In general, the only remaining Work shall be minor in nature, such that Owner may occupy or utilize Work or designated portion there of, and completion or correction of Work by Contractor would not materially interfere or hamper Owner's intended business use or operation.
 - 2. Contractor shall certify that all remaining Work will be completed within 30 consecutive calendar days following date of Substantial Completion, or as agreed to in writing, and failure to do so shall automatically reinstate provisions for damages due Owner as contained elsewhere in Contract Document or as provided by law for such period of time as may be required by Contractor to fully complete Work whether Owner has occupied Work or not.
- B. Obtain evidence of compliance with requirements of governing authorities:
 - 1. Certificates of inspection of:
 - a. Mechanical.
 - b. Electrical.
 - c. Plumbing.
 - d. Etc.

- 2. Certificate of Occupancy.
- C. When Contractor considers that Work, or a portion thereof which Owner agrees to accept separately, is substantially complete, Contractor shall thoroughly inspect Work, and prepare and submit to Field Engineer a comprehensive list of items to be corrected or completed, and Contractor's Notice of Substantial Completion (utilize form at end of this Section).
- D. Contractor certify that:
 - 1. Work performed under this Contract has been thoroughly inspected and considered to be sufficiently complete, in accordance with Contract Documents, so Owner can occupy or utilize Work for its intended use.
- E. Failure of Contractor to include an item on such list(s) does not alter responsibility of Contractor to complete all Work in accordance with Contract Documents.
- F. Contractor shall proceed promptly to complete and correct the items on list.
- G. After receipt of Contractor's comprehensive list of items to be corrected or completed, and Contractor's Notice of Substantial Completion, Field Engineer will, within reasonable period after notification, review list of items to be completed or corrected, or inspect Work, or designated portion thereof, to determine whether Work is Substantially Complete.
- H. If Owner's review or inspection discloses any item, whether or not included on Contractor's list, which is not sufficiently complete in general accordance with Contract Documents so Owner can occupy or utilize Work or designated portion thereof for its intended use:
 - 1. Contractor will be notified stating reasons.
 - 2. Contractor shall substantially complete or correct Work.
 - 3. Contractor shall thoroughly re-inspect Work.
 - 4. Contractor shall submit another Contractor's Notice of Substantial Completion, a revised list of items to be completed or corrected, and a request for another review and inspection.
 - 5. Field Engineer will again review list of items to be completed or corrected and Work.
- I. When Work or designated portion thereof is considered Substantially Complete, Field Engineer will prepare a Certificate of Substantial Completion.
 - 1. The Certificate of Substantial Completion shall establish date of Substantial Completion, shall establish responsibilities of Owner and Contractor for security, maintenance, heat, utilities, damage to Work and insurance, and shall fix time within which Contractor shall complete and correct Work.
 - 2. Warranties required by Contract Documents shall commence on date of Substantial Completion of Work or designated portion thereof unless otherwise provided in Certificate of Substantial Completion.
 - 3. The Certificate of Substantial Completion shall be submitted to Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.
- J. Owner may occupy Project, or designated portion thereof, under provisions agreed to in Certificate of Substantial Completion, and if required, a certificate of occupancy has been issued by governing authorities.
 - 1. If Owner is going to occupy Project, or designated portion thereof, Contractor shall perform final cleaning immediately.

- 2. If Field Engineer discovers any Work which is not complete and/or is not in conformance with Contract Documents, during or after occupying or utilizes Work, whether included on a list or not, Owner shall notify Contractor to complete or correct item(s) identified.
- K. Contractor shall proceed expeditiously with adequate forces to complete or correct Work, and to complete all Project closeout requirements within designated time.
- L. 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.
- M. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by City of Tulsa Representative. Label with manufacturer's name and model number.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit sustainable design submittals not previously submitted.
 - 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- N. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 - 6. Advise Owner of changeover in utility services.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements.

- 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- O. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, City of Tulsa Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Owner's Representative 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 City of Tulsa Representative, that must be completed or corrected before certificate will be issued.

1.6 FINAL COMPLETION PROCEDURES

- A. After Contractor has completed all Work, and has thoroughly inspect Work to determine that it is complete, is in accordance with Contract Documents and Contract is fully performed, Contractor shall submit Contractor's Certificate of Completion to Field Engineer, and the list(s) of items to be completed or corrected initialed to indicate Contractor has verified completion of each item. Utilize form at end of this section. Certify that:
 - 1. Work has been thoroughly inspected by Contractor for compliance with Contract Documents.
 - 2. Work has been completed in accordance with Contract Documents.
 - 3. Equipment and systems have been tested and are operating satisfactorily.
 - 4. Contract closeout requirements have been completed satisfactorily and submitted.
 - 5. Contractor knows of no reason that insurance will not be renewable to cover period required by Contract Documents.
 - 6. Work is ready for final inspection and acceptance.
- B. Submit final closeout submittals required by this and other Sections.
- C. Field Engineer will make final walk through within a reasonable time after receipt of Contractor's Certificate of Completion and final Application for Payment.
- D. Contractor shall remedy any remaining deficiencies or incomplete Work, at Contractor's expense.
- E. When Field Engineer finds Work acceptable under Contract Documents and Contract satisfactorily performed, Field Engineer will promptly issue a final Certificate for Payment.
- F. Neither final payment nor any remaining retained percentage shall become due until Contractor submits to Field Engineer;
 - 1. An affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with Work for which Owner or Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied (AIA Documents G706 and G706A),
 - 2. A certificate evidencing that insurance required by Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to Owner,
 - 3. A written statement that Contractor knows of no substantial reason that insurance will not be renewable to cover period required by Contract Documents,
 - 4. Consent of surety, if any, to final payment (AIA Document G707),
 - 5. Contractor's release or waiver of liens,

- 6. If required by Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of Contract, to extent and in such form as may be designated by Owner, for Owner's review.
- 7. If a Subcontractor refuses to furnish a release or waiver required by Owner, Contractor may furnish a bond satisfactory to Owner to indemnify Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to Owner all money that Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.
- G. 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: Submit certified copy of City of Tulsa Representative's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by City of Tulsa Representative. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Submit pest-control final inspection report.
- H. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, City of Tulsa Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. City of Tulsa Representative 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.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file and one (1) paper copy. City of Tulsa Representative will return annotated file.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of City of Tulsa Representative for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to City of Tulsa Representative.
- D. Warranties in Paper Form:
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents:
 - 1. Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned.
 - 2. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 3. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.
- B. Fire Protection
 - 1. Store volatile waste in covered metal containers.
 - 2. Remove from premises daily.
- C. Pollution Control
 - 1. Conduct cleanup and disposal operations to comply with codes, rules, regulations, ordinances, and anti-pollution laws.
 - 2. Do not burn or bury rubbish and waste on site.
 - 3. Do not discharge volatile, harmful, or dangerous materials into drainage systems.

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: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

- 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean all items installed under this Contract.
 - b. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - c. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - d. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - e. Sweep concrete floors broom clean in unoccupied spaces.
 - f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - g. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - h. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - i. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - j. Leave Project clean and ready for occupancy.
 - k. Leave free of stains, dirt, dust, damage, or defects.
 - 1. Include washing, sweeping, polishing of wall surfaces, floors, windows, hardware, mirrors, lighting fixtures, equipment, etc.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 DURING CONSTRUCTION

- A. Provide on-site containers for the collection of waste materials, debris, and rubbish.
- B. Clean up all waste materials, rubbish, and debris from site and access daily.
- C. Dispose of off site once a week.
- D. Wet down dusty materials and rubbish to prevent blowing dust during entire construction period.
- E. If use of water is prohibited by law, Contractor shall seek an alternate method to prevent blowing dust.
- F. Perform cleaning operations as required during construction to prevent accumulations of dust, soil, and debris.
- G. Clean and protect Work in progress and adjoining materials in place, during handling and installation.
- H. Clean and provide maintenance on completed Work as frequently as necessary through out construction period.
- I. Clean lunch/break area after each use.
- J. Maintain site and building so no condition provides a fire hazard.

3.3 FINAL CLEANING

- A. At Substantial Completion, perform final cleaning of Work and existing areas wherever any area are left less than clean by construction operations.
- B. Complete cleaning operations before requesting review for Substantial Completion.
- C. Use experienced workmen or professional cleaners for final cleaning.
- D. Repair and touch-up marred areas.
- E. Broom clean and remove stains from paved surfaces; rake clean other surfaces of grounds.
- F. Remove grease, dust, dirt, stains, labels, fingerprints, mastic, adhesive, and other foreign materials from interior and exterior surfaces, and fixtures, hardware, and equipment.
- G. Remove temporary protection and facilities installed for protection of the Work during construction.
- H. Prior to Owner occupancy, Contractor and Owner shall conduct an inspection of all Work areas to verify that the Project is clean to the Owner's satisfaction.

3.4 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

CONTRACTOR'S NOTICE OF SUBSTANTIAL COMPLETION

PROJECT:	
ARCH PROJ. NO.: CONTRACT FOR:	CONTRACT DATE:
WORK OR DESIGNATED PORTIO	N SHALL INCLUDE:
 PART 4 - Work performed under this complete, in accordance with Contrat thereof for its intended use. Certificates of inspections indicat to. Certificate of Occupancy have bee A comprehensive list of items to to include any items on such list of with Contract Documents. 	s Contract has been thoroughly inspected and is considered to be sufficientled be be completed by the completed portion of governing authorities, are attached here be completed or corrected, prepared by Contractor is attached, hereto. Failur does not alter responsibility of Contractor to complete all Work in accordance
Contractor will complete or correct W	fort by:
CONTRACTOR.	ork by
BY:	DATE:
OWNER:BY:	DATE:
The Work designated above, has been Substantially Complete and a Ce Not substantially complete for fo	determined to be: ertificate of Substantial Completion will be issued. ollowing reasons:
OWNER'S BKL, Inc. REPRESENT ATIVE: BY:	DATE:
CONTRACTOR'S	S NOTICE OF SUBSTANTIAL COMPLETION
Moha	wk Water Treatment Plant Storage Facility TMUA-W 20-01 April 15, 2021 017700 - 10

CONTRACTOR'S CERTIFICATE OF COMPLETION

PROJECT:	
ARCH. PROJECT NUMBER:	
CONTRACT FOR:	
CONTRACT DATE:	

This is to certify that I am an authorized official of, and have been properly authorized by said firm or corporation to certify following:

I know of my own personal knowledge, and do hereby certify on behalf of Contractor,

that Work has been reviewed and thoroughly inspected for compliance with Contract Documents,

that Work has been completed, in accordance with Contract Documents and Contract is fully performed,

that all equipment and systems have been tested and are operating satisfactorily,

that all Contract closeout requirements have been completed satisfactorily and submitted,

know of no substantial reason that insurance will not be renewable to cover period required by Contract Documents, and Work is ready for final inspection and acceptance.

Attached are three (3) copies of following documents, which are required prior to final payment:

- Final Application for Payment.
- Contractor's Affidavit of Payments of Debts and Claims: AIA Document G706.
- Contractor's Affidavit of Release of Liens: AIA Document G706A.
- Consent of Surety (if any) to Final Payment: AIA Document G707.
- Certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least thirty (30) days' prior written notice has been given to Owner.
- The list(s) of if items which were to be completed and corrected, with each item initialed to indicate Contractor has verified completion or correction of each.
- List of subcontractors and equipment suppliers.
- □ If required by Owner, other data establishing payment or satisfaction of obligations arising out of Contract.
- Transmittal indicating Owner has received Project Record Documents.
- Transmittal indicating Owner has received Operations and Maintenance Manuals
- Transmittals indicating that owner has received Spare Parts, Warranties and Guaranties.

I understand that acceptance of final payment by Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at time of final Application for Payment.

CONTRACTOR:	BY:
TITLE:	DATE:
Subscribed and sworn to me this day of	
NOTARY PUBLIC:	
My commission expires:	
DISTRIBUTION: OWNER OWNER'S REPRESEN	NTATIVE
CONTRACTOR'S CERTI	FICATE OF COMPLETION
Mohawk Water Treatme TMUA- April 1 01770	ent Plant Storage Facility W 20-01 5, 2021 00 - 11

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. Record Samples.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Submit one paper-copy set of marked-up record prints.
 - 2. Submit PDF electronic files of scanned record.
 - 1) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and annotated PDF electronic files 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.

1.3 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.
- e. Cross-reference record prints to corresponding photographic documentation.
- 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Change Directive.
 - k. Changes made following Owner's Representative's written orders.
 - 1. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
- 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
- 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
- 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Owner's Representative
 - e. Name of Contractor.

1.4 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 paper copy and scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.5 RECORD PRODUCT DATA

- 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. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- C. Format: Submit record Product Data as paper copy and scanned PDF electronic file(s) of markedup paper copy of Product Data.
 - 1. Include record Product Data directory organized by Specification Section number and title.

1.6 RECORD SAMPLES

- A. Recording: Maintain one copy of each submittal sample during the construction period for project for record document purposes.
- B. Preparation:
 - 1. Submit manageable samples in a 3 ring binder.
 - 2. When possible, cut samples to 8 x 10 size to fit binder.
 - 3. Include color copies of samples that are too heavy or too large for binder.
- C. Format:

- 1. Insert manageable samples in a plastic sleeve.
- 2. Included on a 8 $\frac{1}{2}$ x 11 card stock. with the following:
 - a. Indicate the product and installation location.
 - b. Note Specification Section and Title and submittal number.
 - c. Note related Change Orders where applicable.
 - d. Note related Change Orders, record Specifications, and record Drawings where applicable.
 - e. Note Specification Section and Title and submittal number with each sample.
- 3. Organize binder by Specification Section number and title.

1.7 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store record documents 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 Owner's Representative's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Design Mixtures: For each concrete mixture.
- D. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

1.3 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.
- C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to owner qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.6 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1.
 - 1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301.
 - 2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.4 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I, gray.
- B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.

- 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
- C. Air-Entraining Admixture: ASTM C 260/C 260M.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
- E. Water: ASTM C 94/C 94M and potable.

2.5 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Normal-Weight Concrete:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Slump Limit: 5 inches.
 - 3. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
 - 4. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.0 lb/cu. yd.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Tool (1/4 IN radius) exterior corners and edges of concrete.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices.

3.3 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Provide 10 ft on center unless otherwise indicated. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3.6 FINISHING FORMED SURFACES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

3.7 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and straightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish.

- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to all surfaces.
 - 2. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3.9 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

END OF SECTION

SECTION 055000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous steel framing and supports
 - 2. Bollards.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.3 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

- B. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normalweight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Where units are indicated to be cast into concrete equip with integrally welded steel anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.6 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- C. Galvanize exterior miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.7 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.8 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

2.10 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

2.11 INSTALLING METAL BOLLARDS

- A. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- B. Fill bollards solidly with concrete, mounding top surface to shed water.

2.12 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonstaining silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Mildew-resistant joint sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Preconstruction laboratory test reports.
- C. Preconstruction field-adhesion-test reports.
- D. Field-adhesion-test reports.
- E. Sample warranties.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.6 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealants: As selected by Architect f rom manufacturer's full range.
 - 1. <u>Basis-of-Design Product:</u> Subject to compliance with requirements, provide product from one of the following or comparable product by one of the following:
 - a. Dow Corning Corporation
 - b. <u>Sika Corporation; Joint Sealants</u>.
 - c. <u>Tremco Incorporated</u>.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
- B. Urethane, S, P, 35, T, NT: Single-component, pourable, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 35, Uses T and NT.

2.4 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.

- 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

- 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

- a. Isolation and contraction joints in cast-in-place concrete slabs.
- b. Tile control and expansion joints.
- c. Joints between different materials listed above.
- d. Other joints as indicated on Drawings.
- 2. Joint Sealant: Urethane.
- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Construction joints in cast-in-place concrete.
- b. Other joints as indicated on Drawings.
- 2. Joint Sealant: Silicone, nonstaining.
- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.

- b. Tile control and expansion joints.
- c. Vertical joints on exposed surfaces of concrete, walls and partitions.
- d. All junctures of dissimilar materials.
- e. Other joints as indicated on Drawings.
- 2. Joint Sealant: Urethane.
- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
- b. Tile control and expansion joints where indicated.
- c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware".

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Steelcraft; an Allegion brand or comparable product by one of the following:
 - 1. Ceco Door; ASSA ABLOY.
 - 2. Curries Company; ASSA ABLOY.
 - 3. Pioneer Industries.

4. Republic Doors and Frames.

2.2 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard insulation material.
 - 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - b. Construction: Full profile welded.
 - 4. Exposed Finish: Prime over A40 coating.

2.3 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Designed to engage pre-engineered framing, welded to back of frames; not less than 0.042 inch thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.4 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).

2.5 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - b. Compression Type: Not less than two anchors in each frame.
 - 5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.

- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.6 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: SDI A250.10.
- B. Factory Finish: SDI A250.3.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

- a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- 3. In-Place Metal framing: Secure slip-on drywall frames in place according to manufacturer's written instructions.
- 4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 083323

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulated service doors.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operating and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 - 1. Design Wind Load: 20 PSF.
 - 2. Testing: According to ASTM E 330/E 330M.

2.2 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Overhead Door Company Stormtite 625.
 - 2. Haas Door 612.
 - 3. Wayne Dalton 800C.
 - 4. Cornell Model ESD20.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000.
- C. Curtain R-Value: 7.7
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 2-5/8-inchcenter-to-center height.
 - 1. Insulated-Slat Interior Facing: Metal.
- F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick fabricated from hotdip galvanized steel and finished to match door.
- G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- H. Hood: Match curtain material and finish.
 - 1. Mounting: Face of wall.
- I. Locking Devices: Equip door with slide bolt for padlock and chain lock keeper.
- J. Electric Door Operator:
 - 1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
 - 2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
 - 3. Motor Exposure: Interior.
 - 4. Motor Electrical Characteristics:
 - a. Horsepower: 3/4 hp.

- b. Voltage: 120-V ac, single phase, 60 Hz. Coordinate electrical requirements w electrical service provided prior to ordering motor
- 5. Emergency Manual Operation: Chain type.
- 6. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
- 7. Control Station(s): Interior mounted
- K. Curtain Accessories: Equip door with weatherseals, astragal and pull-down strap.
- L. Door Finish:
 - 1. Baked-Enamel: Color as selected by Architect from manufacturer's full range.
 - 2. Factory Prime Finish: Manufacturer's standard color.
 - 3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.3 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
 - 2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 22 GA.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent over travel of curtain.

2.5 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

2.6 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.7 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
- B. Astragal for Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- D. Pull-Down Strap: Provide pull-down straps.

2.8 MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.

- 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Motors: Reversible-type motor with controller for motor exposure indicated for each door assembly.
 - 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 - 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
- D. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
- E. Control Station: Three-button control station in fixed location with momentary-contact pushbutton controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with generalpurpose NEMA ICS 6, Type 1 enclosure.
- F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 099000

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Definitions:
 - 1. "Paint" and "painting" refer to applied coatings.
- B. Work included:
 - 1. Paint HM Doors and Frames.
 - 2. Paint Bollards.
 - 3. Paint exposed Yard Hydrant surfaces unless pre-painted.

1.2 QUALITY ASSURANCE

A. American Society for Standards and Testing: 1. ASTM-D3134.

1.3 SUBMITTALS

- A. Product data:
 - 1. Manufacturer's data for each paint type to be applied indicating conformance to specifications.
 - a. Name of material.
 - b. Contents by volume.

B. Samples:

- 1. Manufacturers complete range of colors for selection.
- 2. Gloss samples.
- C. Project information:
 - 1. Letter stating VOC compliance of materials to local regulations.
- D. Contract closeout information:
 - 1. Maintenance data.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver in original labeled containers.
- B. Protect from freezing or damage.
- C. Store materials in place designated by Owner.

- D. Keep storage neat and clean.
- E. Repair damage thereto or to surroundings.
- F. Remove rags and waste from building daily.
- G. Avoid danger of fire.

1.5 JOB CONDITIONS

A. Install when temperature and humidity conditions are appropriate per manufacturer of product.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acceptable manufacturers:
 - 1. Provide paint as product of one manufacturer as far as possible.
 - 2. Contractor may propose products for use, produced by an approved manufacturer when he believes proposed product is equivalent to product listed in specification.
 - 3. Contract Administrator must agree that proposed product is equivalent.
 - 4. If Contract Administrator does not agree that proposed product is equivalent, Contractor will provide product listed in specification.
 - 5. Paint and coating systems listed are Sherwin Williams unless noted otherwise.
 - a. Use comparable quality paints by approved manufacturer.
 - 6. Paints:
 - a. Base:
 - 1) Sherwin Williams.
 - b. Optional:
 - 1) ICI Paint Stores.
 - 2) PPG Architectural Finishes.
 - 3) MAB Paints and Coatings.
 - 4) Diamond Vogel Paint.
 - 5) Moore, Benjamin.
 - 6) Tnemec.
 - 7. Galvanized metal cleaners:
 - a. Great Lakes.
 - 8. Other manufacturers must submit their products to the Architect 10 days prior to the bid date for approval to be considered as an equal.
- B. Paints: As specified in paragraphs "Paint Systems: Exterior" and "Paint Systems: Interior".
 - 1. Use best quality by approved manufacturers.
 - 2. Unspecified products: Use best quality by reputable, recognized manufacturers.
 - 3. Colors: As noted in color schedule and as indicated in Section 15190.
 - a. Specifier: Do not include provision for accent colors if no accent walls or graphics are expected. Check with Interiors.
 - b. Contract Administrator reserves right to select accent colors from entire range of manufacturer's colors, including deep colors.

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- c. Contract Administrator reserves right to require that one or more walls in a room or space be painted a contrasting accent color, except in janitor's and electric closets and other small miscellaneous rooms and spaces.
- 4. Following is a listing of surfaces and type of paint to be applied.
- 5. Submit gloss samples for approval prior to use.
- 6. Add flatteners if necessary, to achieve specified gloss.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces carefully for defects which cannot be corrected and might prevent satisfactory results.
- B. Commencing of work in a specific area constitutes acceptance of surfaces, and responsibility for performance.

3.2 PREPARATION - GENERAL

- A. Assure that surfaces are clean and dry.
- B. Assure that surfaces are free of foreign materials which will affect adhesion or appearance.
- C. Remove mildew and neutralize surface.
- D. Eliminate efflorescence before painting.
- E. Before painting, test surfaces with moisture meter.
- F. Paint when moisture is within paint manufacturer's acceptable limits.

3.3 MATERIAL PREPARATION

- A. Mix and prepare materials per manufacturer's specifications.
- B. Stir, agitate, or blend materials to produce a mixture of uniform density as required for application of materials.

3.4 PREPARATION - FERROUS METAL SURFACES AND HOLLOW METAL

- A. Follow requirements of SSPC SP1 and SP3.
- B. Wire brush or grind as necessary to remove shoulders at edge of sound paint to prevent telegraphing.

C. Touch up damaged shop coats.

3.5 PREPARATION - GALVANIZED METAL SURFACES AND NONANODIZED ALUMINUM

- A. Follow requirements of SSPC SP1.
- B. Treat surfaces with galvanized surface cleaner.

3.6 APPLICATION - GENERAL

- A. Paint surfaces as specified in paragraphs "Schedule Interior Paint Systems" and "Schedule Exterior Paint Systems".
- B. Provide complete coverage and hide.
 - 1. Paint systems are to cover.
 - 2. When color or undercoats show through, apply additional coats at no additional cost until paint film is of uniform finish and color.
- C. Employ only skilled mechanics.
- D. Mix and apply as recommended by manufacturer.
- E. If Contract Administrator so directs, do not apply succeeding coats until he has an opportunity to observe previous coat.
- F. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
- G. Upon completion of painting, carefully replace removed items and/or remove protection.
- H. Apply materials under adequate illumination.
- I. Evenly spread and smoothly flow on for full, smooth cover.
- J. Assure that coats are dry before recoating.
- K. Touch up suction or hot spots in plaster, gypsum wallboard, concrete block, and concrete before painting.
- L. Touch up abraded areas of shop prime coats before subsequent coats are applied.

3.7 APPLICATION - INTERIOR

A. Finish door edges same as faces of doors.

3.8 APPLICATION - EXTERIOR

- A. Do not paint when surface temperature is below 50 degF, while surface is damp, or during cold, rainy or frosty weather.
- B. Avoid painting surfaces exposed to hot sun.

3.9 SURFACES NOT TO BE PAINTED

- A. Anodized aluminum, stainless steel, chromium plate, glass, copper, bronze, or similar materials.
- B. Moving parts of valves, operating units, mechanical and electrical parts, such as valve and damper operators, sending devices, motor, and fan shafts.
- C. Code labels, such as UL, FM.
- D. Equipment identification or rating plates.
- E. Items having complete factory finish.

3.10 PROTECTION AND CLEANUP

- A. Protect adjacent work against damage by painting and finishing work.
- B. Clean, repair or replace, and repaint damaged work as directed by Contract Administrator.
- C. Provide "WET PAINT" signs.
- D. Remove temporary protective wrappings, after completion of operations.
- E. Clean paint spattered surfaces.
- F. Use care not to damage finished surfaces.
- G. Remove surplus materials, scaffolding and debris.
- H. Leave areas broom clean.

3.11 SCHEDULE - PAINT SYSTEMS

- A. Steel:
 - 1. First coat: Epoxy polyamide, Tnemec Series 66 High Build Epoxoline.
 - 2. Second coat: Aliphatic polyurethane, Tnemec Series 74 Endura-Shield.

B. Metals, galvanized, Doors and Frames (semi-gloss finish):

- 1. Clean with Great Lakes "Clean-n-Etch".
- 2. First coat: Epoxy polyamide, Tnemec Series 66 High Build Epoxoline.
- 3. Second coat: Aliphatic polyurethane, Tnemec Series 74 Endura-Shield.
- C. Ferrous metals not galvanized:

- 1. First coat: Epoxy polyamide, Tnemec Series 66 High Build Epoxoline.
- 2. Second coat: Aliphatic polyurethane, Tnemec Series 74 Endura-Shield.

END OF SECTION

SECTION 104416

FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide JL Industries, Inc. or comparable product by one of the following:
 - a. Amerex Corporation.
 - b. Larsens Manufacturing Company.
 - c. Potter Roemer LLC.
 - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- **B.** Fire extinguishers, general purpose: (2 Required)
 - 1. JL, Mercury 15 ¹/₂.
 - 2. Class A,B,C fires
 - 3. Provide hose and horn on each.
 - 4. Finish: Red, in accordance with OSHA requirements.
- C. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated red baked-enamel finish.
- D. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

2.3 MOUNTING BRACKETS (FE)

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 133419

METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural-steel framing.
 - 2. Metal roof panels.
 - 3. Metal wall panels.
 - 4. Translucent roof panels
 - 5. Thermal insulation.
 - 6. Accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and attachments to other work.
- C. Delegated-Design Submittal: For metal building systems.
 - 1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer licensed in the State of Oklahoma responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Name and location of Project.
 - 2. Order number.

- 3. Name of manufacturer.
- 4. Name of Contractor.
- 5. Building dimensions including width, length, height, and roof slope.
- 6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
- 7. Governing building code and year of edition.
- 8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
- 9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
- 10. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- 11. Column reactions on foundations.
- C. Material test reports.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
 - Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
 - 2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

- B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:

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

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

1.6 WARRANTY

- A. Provide building manufacturer's warranty guaranteeing the building system against defects in material for one year from the date of acceptance and shall provide for replacement material as required within that time period.
- B. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, registered in the State of Oklahoma to design metal building system.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
 - 1. The structural steel building frame is an engineered system designed, manufactured and erected by the metal building contractor. The drawings, details and dimensions shown on these documents are representative of the Field Engineer's requirements for the appearance of the final product. The foundation drawings are indicative of the expected loadings transmitted by this system. The metal building manufacturer is allowed to adjust the sizes and shapes in order to design the most efficient system for their product within these guidelines. Changes must be approved by the Field Engineer in writing. No additional compensation will be allowed for changes. The foundations are designed for pinned bases.

- 2. Design Loads: Shall be in accordance with the latest editions of the AISC Allowable Stress Designs Specification for Steel Buildings, AISC Code of Standard Practices for Steel Buildings and Bridges, and the AISI Specification for the Design of Cold Formed Steel Structural Members.
 - a. Wind Loads shall be in accordance with ASCE 7-10, Exposure C, Risk Category II and a wind velocity of 115 MPH.
 - b. Live Load shall be 20 PSF minimum with tributary reduction not allowed as applicable per code.
 - c. Dead Load shall be the weight of the metal building materials.
 - d. Auxiliary Design Loads shall be 5 PSF to cover the dead load imposed by fire protection systems, ceilings and lighting, plus the actual weight of equipment or mechanical units located on or attached to the building. Refer to drawings for location of equipment and mechanical units. Contract Documents must be reviewed by the pre-engineered building engineer to identify any loads that may exceed the 5 PSF limit. Incorporate the necessary structure to carry these loads.
- 3. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
- 4. Deflection and Drift Limits: No greater than the following:
 - a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
 - b. Girts: Horizontal deflection of 1/120 of the span.
 - c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
 - d. Metal Wall Panels: Horizontal deflection of 1/240 of the span.
 - e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - f. Lateral Drift: Maximum of 1/200 of the building height.
- C. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
 - 2. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 3. Wind Loads: As indicated on Drawings.
- E. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..

F. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

H. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for winduplift-resistance class indicated.

1. Uplift Rating: UL 90.

J. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-105.

2. Hail Resistance: SH.

K. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C 1363 or ASTM C 518:

1. Roof:

a. R-Value: R-19.

2. Walls:

a. R-Value: R-11.

2.2 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to

frames; rafters and rake beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

- 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, only with written prior approval by Architect.

2.3 METAL ROOF PANELS

- A. Exposed Fastener, Tapered-Rib, Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 24 ga. nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Exterior Finish: Two-coat fluoropolymer or two-coat Kynar finish.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 2. Major-Rib Spacing: 12 inches o.c.
 - 3. Panel Coverage: 36 inches.
 - 4. Panel Height: 1.125 inches.
 - 5. Standard R-Panel.

2.4 METAL WALL PANELS AND INTERIOR LINER PANELS

- A. Exposed-Fastener, Tapered-Rib, Metal Wall Panels : Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 24 ga. nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Exterior Finish: Two-coat fluoropolymer or two-coat Kynar finish.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 2. Major-Rib Spacing: 12 inches o.c.
 - 3. Panel Coverage: 36 inches.
 - 4. Panel Height: 1.125 inches.
 - 5. Standard R-Panel.

6. Interior liner panels are 26 gauge galvanized.

2.5 TRANSLUCENT ROOF PANELS

A. Translucent roof panels shall consist of the roof panels, their attachments, trim and sealants for use on the exterior of the roof and shall be equal to Palram Americas SunSky 12" polycarbonate panel. Panels to be 8' in length. Other manufacturer's submit for approval prior to bid.

2.6 THERMAL INSULATION

- A. Faced Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- B. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- C. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm when tested according to ASTM E 96/E 96M, Desiccant Method.

2.7 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 - 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
- D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
- E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special

pieces as required. Fabricate in minimum 96-inch-long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

- 1. Gutter Supports: Fabricated from same material and finish as gutters.
- 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.8 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 - 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 - 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 - 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.9 SOURCE QUALITY CONTROL

A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.

- 1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

- 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - 2. Locate and space wall girts to suit openings such as doors and windows.
 - 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, ventilators, and other penetrations of roof and walls.
- H. Steel Joists: Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Joist Installation: Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.
 - 5. Joist Installation: Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
 - 6. Joist Installation: Weld joist seats to supporting steel framework.
 - 7. 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.
- I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 - 1. Tighten rod and cable bracing to avoid sag.
 - 2. Locate interior end-bay bracing only where indicated.
- J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.2 METAL PANEL INSTALLATION, GENERAL

- A. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 - 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
 - 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Locate metal panel splices over structural supports with end laps in alignment.
 - 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- B. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
 - 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
 - 1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.3 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
 - 1. Install ridge caps as metal roof panel work proceeds.
 - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
 - 1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
 - 2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
 - 3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
 - 4. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or selfdrilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.4 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 - 2. Shim or otherwise plumb substrates receiving metal wall panels.
 - 3. When two rows of metal panels are required, lap panels 4 inches minimum.
 - 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 - 5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.

- 6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
- 7. Install screw fasteners in predrilled holes.
- 8. Install flashing and trim as metal wall panel work proceeds.
- 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
- 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
- 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

3.5 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
 - 1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
 - 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
 - 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
 - 1. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 - 2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
 - 1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.6 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Tie downspouts to underground drainage system indicated.
- E. pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 221113

FACILITY WATER DISTRIBUTION PIPING

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. This Section includes water-distribution piping and related components outside the building for water service.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. PA: Polyamide (nylon) plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.10 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Application" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-PW" on piping.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B88, Type Kand ASTM B88, Type M, water tube, drawn temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- B. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- C. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.

2.3 JOINING MATERIALS

- A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.

2.4 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 150 psig.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 150 psig.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solderjoint copper alloy and threaded ferrous.
- 4. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
- 5. Dielectric Nipples:
 - a. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple complying with ASTM F1545.
 - 3) Pressure Rating: 300 psigat 225 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

2.5 GATE VALVES

- A. Bronze Gate Valves:
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>American Valve, Inc</u>.
 - b. Conbraco Industries, Inc.; Apollo Valves.

- c. Crane Co.; Crane Valve Group; Crane Valves.
- d. Hammond Valve.
- e. <u>Milwaukee Valve Company</u>.
- f. <u>NIBCO INC</u>.
- g. <u>Watts Regulator Co.; a division of Watts Water Technologies, Inc.</u>
- 2. OS&Y, Rising-Stem Gate Valves:
 - a. Description: Bronze body and bonnet and bronze stem.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig.
 - 3) End Connections: Threaded.
- 3. Nonrising-Stem Gate Valves:
 - a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleableiron handwheel.
 - 1) Standard: MSS SP-80.

2.6 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Standard: ASSE 1013
 - 2. Operation: Continuous-pressure applications.
 - 3. Pressure Loss: 12 psig
 - 4. Size: refer to plans NPS
 - 5. Body: Bronze for NPS
 - 6. End Connections: Threaded for NPS
 - 7. Configuration: Designed for horizontal, straight through flow.
 - 8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Backflow Preventer Test Kits:
 - 1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with testprocedure instructions.

2.7 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.
 - 1. Option: Base section may be cast-iron, PVC, clay, or other pipe.

- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.

2.8 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C857 and made according to ASTM C858.
 - 1. Ladder: ASTM A36/A36M, steel or polyethylene-encased steel steps.
 - 2. Manhole: ASTM A48/A48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - a. Dimension: 24-inch minimum diameter, unless otherwise indicated.
 - 3. Manhole: ASTM A536, Grade 60-40-18, ductile-iron traffic frame and cover.
 - a. Dimension: 24-inch-minimum diameter, unless otherwise indicated.
 - 4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.9 PROTECTIVE ENCLOSURES

- A. Freeze-Protection Enclosures:
 - 1. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F when external temperatures reach as low as minus 34 deg F.
 - a. Standard: ASSE 1060.
 - b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
 - c. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - 1) Housing: Reinforced fiberglass construction.
 - a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - b) Drain opening for units with drain connection.
 - c) Access doors with locking devices.
 - d) Insulation inside housing.
 - e) Anchoring devices for attaching housing to concrete base.

2) Electric heating cable or heater with self-limiting temperature control.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4shall be the following:
 - 1. Soft copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed copper, pressure-seal fittings; and pressure-sealed joints.
- F. Aboveground and Vault Water-Service Piping NPS 3/4shall be any of the following:
 - 1. Hard copper tube, ASTM B88, Type KASTM B88, Type Lwrought-copper, solder-joint fittings; and brazed copper, pressure-seal fittings; and pressure-sealed joints.
 - 2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented threaded fittings; and threaded joints.
 - 3. NPS ³/₄ fiberglass, AWWA RTRP, Class 250; RTRF; and bonded joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3/4 and Larger: AWWA, cast-iron, rising-stem, metal resilient-seated gate valves with valve box.
 - 2. Use the following for valves in vaults and aboveground:

- a. Gate Valves, NPS 2 and Smaller: Bronze, rising stem.
- b. Check Valves: AWWA C508 UL/FMG, swing type.
- 3. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
- 4. Relief Valves: Use for water-service piping in vaults and aboveground.
 - a. Air-Release Valves: To release accumulated air.
 - b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
 - c. Combination Air Valves: To release or admit air.
- 5. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections NPS 2 and smaller with drilling machine according to the following:
 - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 - 4. Install corporation valves into service-saddle assemblies.
 - 5. Install manifold for multiple taps in water main.
 - 6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Comply with NFPA 24 for fire-service-main piping materials and installation.

- 1. Install PE corrosion-protection encasement according to ASTM A674 or AWWA C105.
- 2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install PE corrosion-protection encasement according to ASTM A674 or AWWA C105.
- G. Install PE pipe according to ASTM D2774 and ASTM F645.
- H. Install PVC, AWWA pipe according to ASTM F645 and AWWA M23.
- I. Install fiberglass AWWA pipe according to AWWA M45.
- J. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inchesbelow level of maximum frost penetration, and according to the following:
 - 1. Under Driveways: With at least 36 inches cover over top.
 - 2. Under Railroad Tracks: With at least 48 inchescover over top.
 - 3. In Loose Gravelly Soil and Rock: With at least 12 inches additional cover.
- K. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- L. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- M. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- N. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- O. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- P. See Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.
- Q. See Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

- A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:

- 1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- 2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
- 3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- 4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
- 5. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
- 6. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D2774 or ASTM D3139 and pipe manufacturer's written instructions.
- 7. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
- 8. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - a. Dielectric Fittings for NPS 3/4: Use dielectric nipples unions.

3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Bolted flanged joints.
 - 5. Heat-fused joints.
 - 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
 - 4. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves.
- H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.9 DETECTOR-CHECK VALVE INSTALLATION

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.10 VACUUM BREAKER ASSEMBLY INSTALLATION

- A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 3/4 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.12 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C891.

3.13 PROTECTIVE ENCLOSURE INSTALLATION

- A. Install concrete base level and with top approximately above grade.
- B. Install protective enclosure over valves and equipment.
- C. Anchor protective enclosure to concrete base.

3.14 CONNECTIONS

- A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.
- B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve or service clamp and corporation valve.
- C. Connect water-distribution piping to interior domestic water piping.

3.15 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.16 **IDENTIFICATION**

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.17 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 230002

MECHANICAL SMALL JOBS

PART 1 - GENERAL

1.1 GENERAL:

A. The General Conditions of specifications and all preceding sections bound herewith are included in and made a part of these sections.

1.2 NOTICE TO BIDDERS:

A. All parties bidding on this work shall be sure that they understand all requirements of the plans, details, these writings, and local conditions thoroughly, for each will be bound by all things appearing therein, should the contract be awarded him, and in case of any obscurity or uncertainty, he shall apply to the engineer in writing for a correct interpretation before submitting his bid.

B. The Contractor is required to coordinate all final connections to equipment being supplied by Contractor and by others before installing any piping. If there is a discrepancy Contractor is to contact Engineer and Architect immediately before proceeding.

C. Contractor is to connect all equipment furnished by owner and indicated on Architectural, Mechanical, and Plumbing sheets.

D. The Mechanical and Plumbing Contractor, prior to bidding the project, shall check Architectural, Civil, Structural, Plumbing, Electrical, Heating and Ventilating plans and specifications to avert possible installation conflicts. Discrepancies shown on different plans and specifications, or other necessary changes shall be brought to the attention of the Architect, Contract Administrator or Engineer for a decision to resolve the conflicts. Failure to coordinated and notify prior to bidding shall be at the contractors expense and there will be no additional cost to the owner or to the project.

1.3 MATERIAL SUBMITTALS:

A. Unless deemed otherwise by the engineer, no single items will receive consideration. Only bound complete submittals will receive consideration. This submittal shall be made within 30 days after awarding of the contract.

B. Submit six (6) copies, bound in six (6) <u>three-ring red binders</u>, to the architect for approval. Submittals to have a table of contents and index tabs for easy reference and usability. Submittals should be **clearly marked** in red to show any changes from the original specifications. In case of
re-submittal, the contractor shall re-submit in quadruplicate showing required corrections and shall continue to re-submit until approval is obtained.

C. All equipment specified herein and noted (S) shall be submitted.

D. Corrections or comments made on submittals and/or shop drawings during review do not relieve the contractor/supplier from compliance with the specifications. This check is only for review of general conformity with the design concept of the project and general compliance with the information given in the contract documents. The sub-contractor or supplier is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction and coordinating his work with that of all other trades (unless specifically stated otherwise in the contract documents).

1.4 COOPERATION:

A. This Contractor shall promptly report to the General Contractor any conditions which might prevent prompt and proper installation of work, or make it unsuitable to connect with or receive work of others. Failure to so report shall constitute acceptance of the work as being fit and proper for completion of this work.

- B. In general, the following priorities shall prevail:
- 1. Ductwork
- 2. Building Drainage
- 3. Piping
- 4. Electrical

1.5 MATERIAL OTHER THAN THOSE SPECIFIED:

A. The base bid and alternate shall include all items as they are specified or detailed in the drawings or approved equals.

B. Where several manufacturers are listed for one use, the contractor may select any of those specified.

C. A request for consideration of items other than those specified may be made to the engineer in writing until ten (10) days before the opening of bids. An Addendum will then be issued listing any materials which may have been approved. There will be no subsequent substitutions.

D. In those cases where an equal product is allowed, the decision as to quality rest with the engineer.

1.6 CLEANING:

A. Upon completion of work, piping systems shall be thoroughly blown down and cleaned out with water wasted to sewer. After thirty (30) days normal operation, contractor shall clean all traps and strainers.

B. All ductwork shall be cleaned (by hand) prior to installation of grilles, diffusers or adjustable turning vanes. After installation of all devices and connection to fan, operate system with all outlets wide open blowing out all dust or refuse.

C. All lighting fixtures, lenses, and panels, shall be cleaned of all dirt, scratches, etc.

1.7 EXCAVATION AND BACKFILLING FOR PIPING:

A. The Contractor shall do all excavating, backfilling, shoring, bailing and pumping for the installation of his work. Sewer lines shall not be used for draining trenches and the end of all pipe and conduit shall be kept sealed and lines left clean and unobstructed during construction. Only material suitable for backfilling shall be piled a sufficient distance from banks of trenches to avoid overloading.

- 1. Unsuitable backfill material shall be removed as directed by engineer. Perform grading necessary to prevent surface water from flowing into trenches or other excavations.
- 2. Sheathing and shoring shall be done as necessary for protection of work and safety of personnel. Unless otherwise indicated, excavation shall be by open cut except that for short sections.
- 3. A trench may be tunneled if in the opinion of the architect, the pipe or duct can be properly installed and backfill can be properly tamped. Three feet minimum cover shall be used for service water lines, sanitary and storm sewers. Two feet minimum cover shall be used for gas, oil, chilled and heating water, steam, condensate, and refrigerant lines. Pipe shall be laid on a graded 4 inch bed of sand.

B. After testing and approval of the pipe lines, trenches shall be backfilled to a depth of 6 inches over the top of pipe with washed river sand. Balance of fill material shall contain no rock, wood or other organic materials, and shall be placed in layers not over 6 inches thick and each layer thoroughly compacted so no later settlement will take place. Backfill shall be brought up to level of ground surface and surface graded to satisfaction of engineer. When under buildings, structures, walks and concrete slabs the entire ditch is to be filled with sand to grade.

C. The Contractor shall install six inches below grade and directly above all domestic water, sanitary sewer, storm sewer, electrical conduits and natural gas lines a standard marking tape. The tape shall consist of a 4 mil insert plastic film specifically formulated for prolonged use underground. It shall be highly resistant to alkalis, acids and other destructive agents found in the soil. Tape shall have a minimum tensile strength of 20 lbs. per 3 inch width strips and a minimum elongation of 500%. Tape shall bear a continuous imprinted message repeated every 16 to 36 inches warning of the installation buried below. The message shall read "CAUTION" and then name the utility buried below. Example: "CAUTION WATER LINE BURIED BELOW". Installation instructions for the tape shall be printed with each message along the entire length. The tape shall be as that manufactured by Reef Industries, Inc., Houston, Texas (Terra Tape) or an approved equal. For those installations involving non-metallic pipe (i.e. PVC, fiberglass etc.) tape shall be aluminum foil encased in two layers of inert plastic film enabling the tape to be inductively located. Terra Tape "D" Warning Tapes are acceptable.

D. Protection of Existing Utilities - Existing utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, or if damaged shall be repaired by Contractor.

1.8 START-UP AND SERVICE:

A. Place all equipment and systems in trial operation and adjust all components for proper operation and balance.

B. On date of final inspection, provide services of qualified personnel to operate equipment. Remove and replace access panels, make equipment adjustments and generally assist the engineer inspector in the complete examination of the work.

C. Free service for seasonal start-up and adjusting of heating and cooling equipment shall extend through the next seasonal start-up following acceptance by the owner. If system is operating on "summer cycle" at acceptance, the Contractor shall provide winter start-up service and free service for adjustments.

1.9 OPERATING INSTRUCTIONS:

- A. Provide operating folio, in duplicate, containing the following:
- 1. Brief typewritten statement of start-up and shut-down sequence for each item of equipment and each system. Statement should refer to valves, switches and starters by both name and assigned number.
- 2. Typewritten or printed installation, operation and maintenance instructions for each item of equipment. This shall include points of lubrication, recommended lubrication frequency, type of lubricant, normal adjustment procedures and trouble shooting procedures.
 - a. This section shall further include name and model number of each item of equipment, the source of repair parts and services, manufacturers' repair lists, and operating characteristic curves for each pump and rated equipment.
- 3. Folio shall be bound and submitted to architect for approval and transmission to owner.

B. All valves, switches, starters, etc. shall be tagged with brass tags and they shall be identified as in the above instructions.

C. One copy of shop drawings covering the control diagram and sequencing "As Built" shall be framed behind glass and mounted where indicated in the equipment room.

1.10 AS BUILT DRAWINGS:

A. Deliver to architect upon completion of work two (2) complete sets of contract drawings (white prints) marked up to show all deviations from indicated installations. Markings shall include:

- 1. Changes in routings of concealed piping.
- 2. Changes in concealed duct sizes and arrangements.
- 3. Changes in electrical circuitry and home runs.
- 4. Other changes to concealed work which affect future maintenance and repair operations.

1.11 GUARANTEE:

A. See General and Supplemental Conditions Sections for guarantees required.

PART 2 - PRODUCTS

2.1 SCOPE OF PROJECT:

The contractor shall furnish all labor, materials, tools, transportation, equipment, services and facilities required for the complete installation of all work as shown on plans and outlined in the specifications. The work shall also include all material, equipment, and apparatus not shown, but which are necessary to make a complete working installation of systems, including meters and valving. The engineer does not guarantee the accuracy of the dimensions of new or existing work. Coordinate each equipment sizes with the location where it is to be installed before ordering. Notify engineer if space does not allow for equipment specified. All such dimensions shall be verified by the Contractor and it is his responsibility to fit all new work to existing.

A. Any sanitary sewage systems, including connections, except as otherwise noted to all fixtures, etc., to sanitary sewer.

B. Domestic cold water system and service to all fixtures and outlets including connections to water main.

- C. Natural gas system services and connections to all openings.
- D. Pipe sleeves, forms for chases in concrete and all supports.
- E. Furnishing and installing of all plumbing fixtures.

F. All excavation and backfill necessary for installation of all underground utility and plumbing work and all cutting required to complete the work.

G. Furnishing and installing heating and ventilating equipment with all piping.

2.2 WORK TO BE DONE BY GENERAL CONTRACTOR IN CONNECTION WITH MECHANICAL SECTION:

Build into the building construction all pipe sleeves and bolt inserts for pipe hangers and piping. Pipe sleeves and bolt inserts will be furnished by the Mechanical Contractor. Contractor shall furnish roof and wall openings and furring as required for vents, piping, ducts and louvers. He shall also do all painting and patching required.

2.3 PIPE AND FITTINGS:

A. Any and all sewer and drainage lines in building under driveways, walls, etc., and to 5' outside of buildings are to be constructed of service weight cast iron pipe and fittings of Western Foundry Company, or other approved equal manufacturer and have the manufacturer's name cast on same. C.I. sewer below grade "In Soil" may use "Dual-Tite" gaskets for joints. Above grade to be lead and oakum or Western Foundry "No-Hub" system.

B. All domestic water lines inside building and above grade shall be type "L" hard drawn copper. Water pipe below grade "K" as made by Anaconda, Mueller, or Revere. Below grade

piping inside building shall be coated and wrapped as per gas piping. Fittings are to be solder type wrought copper long radius fittings of make specified above. Hot and cold lines larger than 2-1/2" may be G.I. Schedule 40 pipe.

C. All nipples used to be of the same material as the pipe but shall be extra heavy weight.

D. All drain lines from machinery bases and other items of equipment shall be Schedule 40 galvanized steel pipe with screw cast iron drainage fittings.

E. Gas piping shall be Schedule 40 black steel pipe, with malleable iron screw fittings. Underground gas piping shall be coated and wrapped. Exposed piping to be painted as per Arch. Specifications on "Exposed Metal".

F. Any equipment with domestic water or any piping shall be able to be removed from the piping immediately at the unit without cutting the piping. This is to be accomplished with flanges or unions. This is to be considered standard practice and shall be done whether indicated on the drawings or not.

2.4 VALVES

A. Interior - Install valves on each fixture and each bank of fixtures and elsewhere shown on plans. All valves shall be acceptable and fully equal in area to the pipes on which they are placed.

B. All valves used on iron or steel lines shall be as the following schedule. Crane numbers shown, but equal valves as manufactured by Jenkins, Walworth, and Lunkenheimer may be used.

ТҮРЕ	2" AND BELOW	2-1/2" AND 3"	ABOVE 3"
Gate Valve	440	461	461
Globe Valve	1	351	351
Check Valve	34	373	373
Ball Valve	2190H		

C. All valves used on copper lines shall be as the following schedule. Crane numbers shown but equal valves as manufactured by Jenkins, Walworth and Lunkenheimer may be used.

Gate Valves	1324
Globe & Angle Valves	1310
Check Valves	1342
Ball Valves	2190H

D. Butterfly Valves - Valves shall have cast iron bodies, stainless steel stems, bronze discs, and EPDM seats and seals. Butterfly valves for chilled or secondary water service shall have necks extending 2" above the outside diameter of the companion flanges. Crane Monarch Model No. 23 with 7 position safety twist-lock operator.

E. All equipment shall be valved so that it can be removed without draining system whether indicated on drawings or not.

F. Valves shall be designated for work pressure of 125 psi.

2.5 UNION, HANGERS, AND MISCELLANEOUS:

A. Unions shall be as the following schedule. Crane Company descriptions shown. Union materials to match pipe.

KINDS OF PIPE AND SIZES		UNIONS
Copper	3" & Less	633 Sweat Type
	523-1/2 G.J.	Screw Type
Iron or Steel	3" & Less	Standard Screwed M.I.
Iron or Steel	Over 3"	Standard Flanged M.I.

B. Install Grinnel or an approved equal pipe hanger and supports for copper pipe shall be brass or bronze. Insulate pipes to have 6", 16 ga. half round saddles to protect insulation.

C. Fittings shall correspond to the pipe.

D. Wherever pipes pass through walls, floors, or ceilings, install chromium plated brass escutcheons. Dearborn or equal #1119 sizes to 2", above 2" #1149 or #1152 (17 ga. minimum).

2.6 SLEEVES

A. At all places where piping passes through the construction, this Contractor shall install sleeves of the proper size for insulation. Sleeves to be Schedule 40 steel pipe. The length shall be such that the bends will be flush with the floor and partition surfaces. Use proper sized LINK-SEAL to cap ends.

B. At all places where ductwork and piping passes through existing walls, the wall shall be scored and neatly cut by use of concrete saws. Tolerances of over 1/2" around ducts and pipes will not be permitted. Holes through concrete floors and walls shall be made by a corebore machine as manufactured by Truce or equal.

2.7 PIPING

A. All piping shall be installed in a neat and workmanlike manner, and unless shown otherwise, it shall run parallel to the building lines. Changes in direction shall be at right angles. Changes in directions shall be made by using appropriate fittings, and in no case shall change of directions be made by bending of pipe. Before any pipe is installed, it shall be carefully inspected for defects and it shall be thoroughly cleaned out.

B. They shall be standard, tapering, clean cut threads. No running threads will be allowed. Thread joints shall be made up using an approved lubricant applied to the male threads. Change of pipe size shall be made with eccentric fittings. Bushings will not be permitted. All threads shall be right-hand. Closed nipples shall be used only when absolutely unavoidable. Dissimilar metal pipes will be joined by an insulated coupling.

C. Pieces of pipe shall be cut accurately in lengths and installed without forcing or springing. Lines to receive insulation shall be at least 4 inches apart in clear between bare pipes. For application of insulation, full provision shall be made for expansion and contraction of all piping to allow no injury to any part of the system.

D. Cathodic Protection - At each entrance to building and at each side of meter, provide 17 pound down-metal magnesium anode packaged with prepared backfill mix, installed in strict accordance with manufacturer's instruction using special clamp and #10 insulated copper wire.

E. Note: All refrigerant piping to be Sil-Fossed in nitrogen atmosphere only.

2.8 SEWAGE DISPOSAL SYSTEM:

A. In each change of direction of soils and wastes and at foot of each riser and in all horizontal runs more than 30' in length, provide a brass screw cleanout in soil pipe and connect to same with "Y" bends and 1/8" bends made flush with floor or wall. Locations of such cleanouts are to be checked with the Architect. All cleanouts are to be same size as pipe up to 4" diameter and 4" for all larger pipes.

B. All stacks and vents shall be properly supported from the construction. On vertical pipes, use heavy clamps fastened to floor framing at floor and proportioned for size and weight of pipes. Horizontal runs shall be supported on rod and ring hangers not over 6'-0" apart. No strap or wire hangers will be accepted.

C. Cleanouts in all outside lines shall be furnished in cast iron soil pipe and fittings with heavy brass cleanout plugs, eighth bends, etc., and shall be set in concrete for minimum of distance of nine (9) inches each way from outside of hub, and for the length of the vertical drop and shall completely encase the bends.

2.9 FLASHINGS:

Flash around all pipes passing through roofs in connection with this contract with sheet lead, not less than 4 pounds to the square foot built 6" into the waterproofing, running 10" up the pipe and turned over into the pipe cavity. Cooperate with the Roofing Contractor when installing flashings.

2.10 WATER HAMMER ARRESTORS:

Water hammer arrestors shall be installed. The arrestors shall be located within an effective range of the quick closing valve. Water hammer arrestors shall be accessible and conform to ANSI A1112.26.1. Submit on size and location of absorbers. Wade shock absorbers or Josam 1485 are approved.

2.11 DRIPS, OVERFLOWS, AND DRAINS:

Contractor shall run all drips, overflows and drains to the nearest floor drain using galvanized steel pipe and galvanized malleable fittings or copper pipe and fittings. 1/4" copper may be used for air vents and drains.

2.12 **PIPING INSULATIONS:**

The Contractor shall apply insulation to the following services:

A. All domestic cold, hot and tempered water shall be insulated with 1/2" Certain-Teed Snap-on pipe insulation 3-1/2# density with factory applied white sisal craft and foil vapor barrier. Also all drainage lines (sanitary storm sewer) run over open spaces, or ceilings, or in chases where condensation could occur, shall be insulated with 1/2" Certain-Teed Snap-on pipe insulation 3-1/2# density with factory applied white sisal craft and foil vapor barrier. Fiberglass strips secured with glass tape, shall be secured to all fittings, valves, etc., and covered with insulating cement (palmed smooth) and canvased. In addition, all exposed pipe to be 6 oz. canvased or covered with glass cloth ready for painting.

B. Equal insulation by Johns-Manville, Owens-Corning, Pittsburg and Armstrong will be acceptable.

2.13 SHEETMETAL INSULATION AND ACOUSTICAL LINER:

A. All installed sheetmetal duct above grade and not exposed to be insulated with 2" CSG Universal #751 fiberglass blanket 3/4# density with fire rated aluminum foil and sisal paper seal with 2" overlap. All joints are to be lapped, and taped and sealed with an approved adhesive unless otherwise noted on plans. Owens-Corning and Certainteed products will be acceptable.

B. The first five feet of supply air, return air, fresh air, exhaust air and exposed supply duct shall be lined with 1" 3 lbs/cu ft Certainteed Ultralite fiberglass insulation. 100% of the liner shall be covered (except for exhaust air) with an approved adhesive. Below grade ductwork is not to be insulated.

C. Duct sizes shown on plans to be free opening sizes.

2.14 Louvers:

All louvers are to be of the size, make, finish and manufacturer as specified on the grille schedule shown on plans. All exterior wall louvers and penthouses are to have an annodized aluminum finish, color to be selected by Architect unless otherwise identified on the plans. Carnes, Titus and Metal*Aire are approved in name only and must comply with the plans and specifications.

2.15 EXHAUST AND VENTILATING SYSTEM:

Furnish and install a complete exhaust and ventilating system as shown in the drawings and called for in the equipment scheduled on plans.

2.16 TESTING:

A. After all vertical lines and soils, waste vents, etc., have been set from the ground floor to the top of the building, all outlets shall be temporarily plugged up. The pipe shall be filled with water, full to the top and allowed to remain for six hours.

B. A final test shall be made after all vertical and horizontal pipes and roughing-in has been made and before the sewer connections are made. In this case as before, all pipes shall be filled to the top to the vertical lines and allowed to remain for six hours.

C. In case of any defects, they shall be made good to the satisfaction of the Engineer and the work retested without delay. All such work shall be done by the Plumbing Contractor without additional charge.

D. Notice shall be given to the Engineer and governing agency before tests are made and the water is not to be drawn off the pipes, or the pipes covered until the filled pipes have been examined by the Engineer and inspector.

E. All domestic water piping shall be tested with 100 psi.

2.17 ANCHORING OF FLUSH VALVES, ETC.:

All flush valves, wall hydrants or any other device being served from piping in wall, shall have the connected piping securely anchored to the wall by use of angle iron and clamps or similar method. No wedging of these pipes will be accepted.

2.18 VIBRATION:

The Contractor shall take those precautions he deems advisable in addition to those set out in the plans and specifications, for the elimination of noise and vibration. The Contractor will be held strictly accountable for the noises and vibration transmitted to the occupied spaces of the building. If objectionable noise or vibration is present after the job is completed, the Contractor shall take all necessary steps for their elimination without any additional cost to the Owner. The means of eliminating noise and vibrations shall, in general, be that recommended by the manufacturer of the equipment which is furnished for this job.

2.19 BELT DRIVES:

All belt drives shall be of the multiple "V" type, Dayton or Gates. Provide variable pitch motor sheaves on all fan drives. Provide standard slide rails, or other means of belt adjustments, for each motor with a belt drive.

2.20 BELT AND COUPLING GUARDS:

Provide removable steel guards over all exposed belt drives and couplings. Guards shall conform to applicable state and local safety requirements.

2.21 EXISTING CONDITIONS:

The existing piping, conduit ductwork, etc., have been referenced to original plans and on-job observations. If during construction radically different conditions are found, the Contractor shall so notify the Architect or Engineer and on-the-job corrections shall be made. Note the contractor shall verify that the water pressure at the site is sufficient to operate the flush valves specified before ordering the valves and water closets. All flow lines of existing drainage lines shall be verified before beginning excavation for new piping. Verify all site grades before beginning excavation to assure proper covering of new piping.

2.22 BUILDING CODES:

This project is to be installed to satisfy the most current International Mechanical, Plumbing, Fuel & Gas, Building, Fire Codes and NFPA (I.B.C., I.M.C., I.F.C., I.F.G.C., & I.P.C.). The mechanical contractor for this project is to be one who shall be totally familiar with these codes. The contract documents (plans and specifications) are not step by step instructions. Their intent is to establish the minimum standard of performance that is acceptable for this project. If any system, device, piping, etc. is not mentioned in the contract documents and is required to meet the Codes and any applicable local city, county or state codes, the Contractor shall install the item per code as part of the base contract with no additional compensation.

END OF SECTION

SECTION 238239.19

WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 1. Detroit
- 2. Modine
- 3. Trane

2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

A. Front Panel: Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.

- B. Finish: Baked enamel over baked-on primer with manufacturer's custom color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated, multispeed. Comply with requirements in Division 23 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

- A. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

2.7 CAPACITIES AND CHARACTERISTICS

A. See scheduled requirements on plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION

SECTION 260000

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Requirements under Division 1 and the general and supplementary conditions of these specifications apply to this section and division. Where the requirements of this section and division exceed those of Division 1, this section and division take precedence. Become thoroughly familiar with all their contents as to requirements that affect this division, section or both. The work required under this section includes material, equipment, appliances, transportation, services, and labor required to complete the entire system as required by the drawings and specifications, or reasonably inferred to be necessary to facilitate each system's functioning as implied by the design and the equipment specified.
- B. The specifications and drawings for the project are complementary, and portions of the work described in one, shall be provided as if described in both. In the event of discrepancies, notify the engineer and request clarification prior to proceeding with the work involved.
- C. Drawings are graphic representations of the work upon which the contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They also convey the scope of work, indicating the intended general arrangement of the equipment and other materials without showing all of the exact details as to elevations, offsets, control lines, and other installation requirements. Use the drawings as a guide when laying out the work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all contract documents. Correct errors that could have been avoided by proper checking and inspection, at no additional cost to the owner.
- D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the contract is based.

1.2 DEFINITIONS

- A. Whenever used in these specifications or drawings, the following terms shall have the indicated meanings:
 - 1. Furnish: "to supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."
 - 2. Install: "to perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use."

- 3. Provide: "to furnish and install complete, and ready for the intended use."
- 4. Furnished by owner (or owner-furnished) or furnished by others: "an item furnished by the owner or under other divisions or contracts, and installed under the requirements of this division, complete, and ready for the intended use, including all items and services incidental to the work necessary for proper installation and operation. Include the installation under the warranty required by this division.
- 5. Engineer: where referenced in this division, "engineer" is the engineer of record and the design professional for the work under this division, and is a consultant to, and an authorized representative of, the architect, as defined in the general and/or supplementary conditions. When used in this division, it means increased involvement by, and obligations to, the engineer, in addition to involvement by, and obligations to, the "architect".
- 6. AHJ: the local code and/or inspection agency (authority) having jurisdiction over the work.
- 7. NRTL: nationally recognized testing laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA), and acceptable to the AHJ over this project.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, certified, or all three, by an NRTL, and acceptable to the AHJ over this project.

1.3 PRE-BID SITE VISIT

A. Prior to submitting bid, visit the site of the proposed work and become fully informed as to the conditions under which the work is to be done. Failure to do so will not be considered sufficient justification to request or obtain extra compensation over and above the contract price.

1.4 MATERIAL AND WORKMANSHIP

- A. Provide all material and equipment new and in first class condition. Provide markings or a nameplate for all material and equipment identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. In general, provide the following quality grade(s) for all materials and equipment:
- B. Work performed under this contract shall provide a neat and "workmanlike" appearance when completed, to the satisfaction of the architect and engineer. Workmanship shall be the finest possible by experienced mechanics of the proper trade.
- C. The complete installation shall function as designed and intended with respect to efficiency, capacity, noise level, etc. Abnormal or excessive noise from equipment, devices or other system components will not be acceptable.
- D. Remove from the premises waste material present as a result of work. Clean equipment installed under this contract to present a neat and clean installation at the termination of the work.
- E. Repair or replace public and private property damaged as a result of work performed under this contract to the satisfaction of authorities and regulations having jurisdiction.

1.5 MANUFACTURERS

- A. In other articles where lists of manufacturers are introduced, subject to compliance with requirements, provide products by one of the manufacturers specified.
- B. Where a list is provided, manufacturers listed are not in accordance with any ranking or preference.
- C. Where manufacturers are not listed, provide products subject to compliance with requirements from manufacturers that have been actively involved in manufacturing the specified product for no less than 5 years.

1.6 COORDINATION

- A. Coordinate all work with other divisions and trades so that the various components of the systems will be installed at the proper time, fit the available space, and will allow proper service access to those items requiring maintenance. Refer to all other division's drawings, and to relevant equipment submittals and shop drawings to determine the extent of clear spaces. Components which are installed without regard to the above shall be relocated at no additional cost to the owner.
- B. Unless otherwise indicated, the general contractor will provide chases and openings in building construction required for installation of the systems specified herein. Contractor shall furnish the general contractor with information where chases and openings are required. Make all offsets required to clear equipment, beams and other structural members, and to facilitate concealing system components in the manner anticipated in the design. Keep informed as to the work of other trades engaged in the construction of the project, and execute work in a manner as to not interfere with or delay the work of other trades.
- C. Figured dimensions shall be taken in preference to scale dimensions. Contractor shall take his own measurements at the building, as variations may occur. Contractor will be held responsible for errors that could have been avoided by proper checking and inspection
- D. Provide materials with trim that will properly fit the types of ceiling, wall, or floor finishes actually installed. Model numbers listed in the construction documents are not necessarily intended to designate the required trim.

1.7 ORDINANCES, CODES, AND STANDARDS

A. Work performed under this contract shall, at a minimum, be in conformance with applicable national, state and local codes having jurisdiction. Equipment furnished and associated installation work performed under this contract shall be in strict compliance with current applicable codes adopted by the local AHJ including any amendments and standards as set forth by the National Fire Protection Association (NFPA), Underwriters Laboratories (UL), Occupational Safety and Health Administration (OSHA), American Society of Mechanical Engineers (ASME), American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), American National Standards Institute (ANSI), American Society of Testing Materials (ASTM) and other national standards and codes where applicable. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services.

- B. Where the contract documents exceed the requirements of the referenced codes, standards, etc., the contract documents shall take precedence.
- C. Promptly bring all conflicts observed between codes, ordinances, rules, regulations, referenced standards, and these documents to the engineer's attention for final resolution. Contractor will be held responsible for any violation of the law.
- D. Procure and pay for permits and licenses required for the accomplishment of the work herein described. Where required, obtain, pay for and furnish certificates of inspection to owner. Contractor will be held responsible for violations of the law.

1.8 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Store and protect from damage equipment and materials delivered to job site, in accordance with manufacturers' recommendations. For materials and equipment susceptible to changing weather conditions, dampness, or temperature variations, store inside in conditioned spaces. For materials and equipment not susceptible to these conditions, cover with waterproof, tear-resistant, heavy tarp or polyethylene plastic as required to protect from plaster, dirt, paint, water, or physical damage. Equipment and material that has been damaged by construction activities will be rejected, and contractor shall furnish new equipment and material as required at no additional cost to the owner.
- B. Keep premises broom clean from foreign material created during work performed under this contract. Piping, equipment, etc. shall have a neat and clean appearance at the termination of the work.
- C. Plug or cap open ends of conduits while stored and installed during construction when not in use to prevent the entrance of debris into the systems.

1.9 SUBSTITUTIONS

- A. Include in the base bid the products specifically named in these specifications or on the drawings. Submit, in the form of alternates, with bid, products of any other manufacturers for similar use, provided the differences in cost, if any, are included for each proposed alternate.
- B. No substitutions will be considered with receipt of Bids, unless the Architect and Engineer have received from the Bidder a written request for approval to bid a substitution at least ten calendar days prior to the date for receipt of Bids, and have approved the substitution request. Include, with each such request, the name of the material or equipment for which substitution is being requested, and a complete description of the proposed substitution, including drawings, cut sheets, performance and test data, and all other information necessary for an evaluation. Include also a statement setting forth changes in other materials, equipment or other work that would be required to incorporate the substitution. The burden of proof of the merit of the proposed substitute is upon the proposer. The proposer of any substitutions shall compensate the Engineer at a rate of \$150.00 per hour for time spent evaluating proposed substitutions and or the subsequent revisions to the design required to utilize the substitution.
- C. The Architect's or Engineer's decision to approve or disapprove a substitution in a Bid is final.

- D. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner, including verbal.
- E. No substitutions will be considered after receipt of Bids and before award of the Contract.
- F. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 SUBMITTALS

- A. Assemble and submit to the architect, for engineer's review, manufacturers' product literature for material and equipment to be furnished, installed, or both, under this division, including shop drawings, manufacturers' product data and performance sheets, samples, and other submittals required by this division. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Provide the number of submittals required by division 1; however, at a minimum, submit two (2) sets. Before submitting, verify that all materials and equipment submitted are mutually compatible and suitable for the intended use, fit the available spaces, and allow ample and code-required room for access and maintenance. Submittals shall contain the following information. Submittals not so identified will be returned to the contractor without action:
 - 1. The project name.
 - 2. The applicable specification section and paragraph.
 - 3. The submittal date.
 - 4. The contractor's stamp, which shall certify that the stamped drawings have been checked by the contractor, comply with the drawings and specifications, and have been coordinated with other trades.
- B. Submittals and shop drawings shall not contain HP Engineering's firm name or logo, nor shall it contain the HP Engineering's engineers' seal and signature. They shall not be copies of HP Engineering's work product.
- C. Transmit submittals as early as required to support the project schedule. Allow for two weeks engineer review time, plus mailing time, plus a duplication of this time for re-submittals, if required. The engineer's submittal reviews will not relieve the contractor from responsibility for errors in dimensions, details, size of members, or quantities; or for omitting components or fittings; or for not coordinating items with actual building conditions.
- D. Refer to division 1 for acceptance of electronic submittals for this project. For electronic submittals, contractor shall submit the documents in accordance with the procedures specified in division 1. Contractor shall notify the architect and engineer that the shop drawings have been posted. If electronic submittal procedures are not defined in division 1, contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, contractor shall copy the architect and engineer's designated representatives. Contractor shall allow the engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the electronic submittal and shall clearly indicate the materials, performance criteria and accessories being proposed. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

1.11 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, contractor may, as an option, obtain electronic drawing files in Revit, AutoCAD, or DXF format from the engineer for a fee of \$300 for a drawing set up to 10 sheets plus \$25 per sheet in excess of 10 sheets. Contact the architect for written authorization; and, contact the engineer to obtain the necessary release agreement form and to indicate the desired shipping method and drawing format. In addition to payment, architect's written authorization and engineer's release agreement form must be received before electronic drawing files will be sent.

1.12 OPERATION AND MAINTENANCE MANUALS

- A. Submit to the architect, for engineer's review, copies each of operations and maintenance instruction manuals, appropriately bound into manual form including approved copies of the following, revised if necessary to show system and equipment as actually installed. Paper clips, staples, rubber bands, and mailing envelopes are not considered approved binders. Provide the number of submittals required by Division 1; however, at a minimum, submit two (2) sets, and include, at a minimum, the following information:
 - 1. Cover sheet that lists the project name, date, owner, architect, consulting engineer, general contractor, sub-contractor, and an index of contents.
 - 2. Manufacturers' catalogs and product data sheets
 - 3. Wiring diagrams
 - 4. Operation and Maintenance instructions
 - 5. Parts lists
 - 6. Approved shop drawings
 - 7. Test reports as defined in NETA ATS for the systems and equipment provided or furnished or installed under this contract.
 - 8. Names, addresses, telephone numbers, and e-mail addresses of local contacts for warranty services and spare parts.
- B. Submit manuals prior to requesting the final punch list and before any requests for substantial completion. Final approval of this division's systems installed under this contract will be withheld until this equipment brochure is received and deemed complete by the architect and engineer.
- C. Provide "as-built" drawings (see Division 1 and general conditions).

1.13 TRAINING

- A. At a time mutually agreed upon between the owner and contractor, provide the services of a factory trained and authorized representative to train owner's designated personnel on the operation and maintenance of the equipment provided for this project.
- B. Provide training to include but not be limited to an overview of the system and/or equipment as it relates to the facility as a whole; operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention; and review of data included in the operation and maintenance manuals.

- C. Submit a certification letter to the architect stating that the owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The contractor and the owner's representative shall sign the certification letter indicating agreement that the training has been provided.
- D. Schedule training with owner with at least 7 days advance notice.

1.14 WARRANTIES

- A. Warrant each system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of substantial completion, unless specific items are noted to carry a longer warranty in the construction documents or manufacturer's standard warranty exceeds this duration. Warranties shall include labor and material. Remedy all defects, occurring within the warranty period(s), as stated in the general conditions and Division 1 without any additional costs to the owner.
- B. Perform any required remedial work promptly, upon written notice from the engineer or owner.
- C. At the time of substantial completion, deliver to the owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the required period, each warranty instrument being addressed to the owner and stating the commencement date and term.

1.15 MISCELLANEOUS REMODELING WORK

A. Provide all demolition of existing electrical systems and new electrical system modifications required because of building remodeling, as noted on the drawings, or necessary for proper operation and new construction. Remove all abandoned cables and wiring above accessible ceilings and ventilation shafts.

PART 2 - ELECTRICAL WORK

2.1 BUILDING OPERATION

A. Comply with the schedule of operations as outlined in the architectural portions of this specification. Building shall be in continuous operation. Accomplish work that requires interruption of building operation at a time when the building is not in operation, and only with written approval of building owner and/or tenant. Coordinate interruption of building operation with the owner and/or tenant a minimum of 7 days in advance of work.

2.2 EXCAVATION AND BACKFILLING

A. Perform excavation and backfill required for installation of underground work under this contract. Trenches shall be of sufficient width. Crib or brace trenches to prevent cave-in or settlement. Do not excavate trenches close to columns and walls of building without prior consultation with the architect. Use pumping equipment if required to keep trenches free of water. Backfill trenches in maximum 6" layers of well-tamped dry earth in a manner to prevent future settlement.

B. Excavation as herein specified shall be classified as common excavation. Common excavation shall comprise the satisfactory removal and disposition of material of whatever substances and of every description encountered, including rock, if any, within the limits of the work as specified and shown on the drawings. Excavation shall be performed to the lines and grades indicated on the drawings. Excavated materials which are considered unsuitable for backfill, and surplus of excavated material which is not required for backfill, shall be disposed of by the contractor at his own expense and responsibility, and to the satisfaction of the architect.

2.3 COINCIDENTAL DAMAGE

A. Repair all streets, sidewalks, drives, paving, walls, finishes, and other facilities damaged in the course of this work. Repair materials shall match existing construction. All backfilling and repairing shall meet all requirements of the owner, city and others having jurisdiction. Repair work shall be thoroughly first class. Conform to all requirements of Division 2 of these specifications.

2.4 CUTTING AND PATCHING

A. Following the requirements in Division 1, cut walls, floors, ceilings, and other portions of the facility as required to perform work under this division. Obtain permission of the architect, owner, or both, before doing any cutting. Cut all holes as small as possible. Patch walls, floors, and other portions of the facility as required by work under this division. All patching shall be thoroughly first class and shall match the original material and construction, including fire ratings if applicable in a manner satisfactory to the architect.

2.5 ROUGH-IN

A. Coordinate without delay all roughing-in with other divisions. Conceal all piping and rough-in except in unfinished areas and where otherwise indicated in the construction documents.

2.6 SUPPORT SYSTEMS

A. Steel slotted support systems (slotted channel): comply with MFMA-3, factory-fabricated components for field assembly; 12-gauge, 1-5/8-inch by 1-5/8-inch; Cooper B-Line, Erico International Corporation, Hilti, Inc., Power-Strut, Thomas & Betts Corporation, Unistrut.

B. Finishes:

- 1. Metallic coatings: hot-dip galvanized after fabrication and applied according to MFMA-3.
- 2. Nonmetallic coatings: manufacturer's standard PVC, polyurethane or polyester coating applied according to MFMA-3.
- 3. Painted coatings: manufacturer's standard painted coating applied according to MFMA-3
- 4. Stainless steel: type 304, per ASTM A240.
- C. Aluminum slotted support systems (slotted channel): comply with MFMA-3, type 6063-T6, per ASTM B221; factory-fabricated components for field assembly; 12-gauge, 1-5/8-inch by 1-5/8-

inch; Cooper B-Line, Erico International Corporation, Hilti, Inc., Power-Strut, Thomas & Betts Corporation, Unistrut.

- D. Field Fabrication:
 - 1. Where field cutting of standard lengths of channel are required, make cuts straight and perpendicular to manufactured surfaces.
 - 2. For field-cut or damaged surfaces of coated channels, dress cut ends, damaged surfaces, or both, with an abrasive material (e.g., file, grinding stone, or similar) and cleanser to remove oils, rust, sharp edges and shards.
 - 3. For channel with a factory-applied coating, re-finish cut edges with a coating compatible with the factory finish and as recommended by the manufacturer (e.g., manufacturer's touch-up paint or zinc-rich cold-galvanizing compound, as applicable).

2.7 PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of fire-stopping specified in Division 7 section "through-penetration firestop systems."

B. Roofs:

- 1. Coordinate all roof penetrations with engineer, owner, and as applicable, the roofing contractor providing a roof warranty.
- 2. Keep all raceway penetrations within mechanical equipment curbs wherever possible. Coordinate with all other applicable Division's work.
- 3. Flash and counterflash all openings through roof, and/or provide pre-fabricated molded seals compatible with the roof construction installed, or as required by the engineer, owner, or roofing contractor. All roof penetrations shall be leak-tight at the termination of the work and shall not void any new or existing roof warranties.
- C. Walls and Floors
 - 1. Sleeves for raceways and cables
 - 2. Steel pipe sleeves: ASTM A 53/A 53M, type E, grade B, schedule 40, galvanized steel, plain ends and drip rings.
 - 3. Cast-iron pipe sleeves: cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Sleeves for rectangular openings: galvanized sheet steel with minimum 0.138 inchthickness and of width and length to suit application.

2.8 FIRE-STOPPING THROUGH PENETRATIONS

- A. Fire-resistant through penetration sealants: two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, raceways, and cable tray penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by underwriters' laboratories, inc., or other NRTL acceptable to AHJ.
- B. Acceptable manufacturers:

- 1. Hilti, Inc.
- 2. 3m Corp.
- 3. Rectorseal.
- 4. Specify Technology Inc.
- 5. United States Gypsum Company.
- C. Submittals
 - 1. Submit product data, manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Division 1.
 - 2. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineering judgment shall include both project name and contractor's name who will install firestop system as described in drawings.
 - 3. Submit material safety data sheets provided with product delivered to job-site.

2.9 CONCRETE BASES

- A. Provide concrete bases (e.g., housekeeping pads) for equipment where indicated on the drawings and as specified herein. Concrete bases shall have chamfered edges. Size of base shall be a minimum of 2 inches greater than the footprint of the equipment that it is supporting.
- B. Construct equipment bases of a minimum 28-day, 4000-psi concrete conforming to American Concrete Institute standard building code for reinforced concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 type I, aggregate conforming to ASTM C33, and potable water. Exposed exterior concrete shall contain 5 to 7 percent air entrainment.
- C. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases with no. 4 reinforcing bars conforming to ASTM A 615 or 6x6 w2.9 x w2.9 welded wire mesh conforming to ASTM A185. Place reinforcing bars 24 inches on center with a minimum of two bars each direction.
- D. Provide galvanized anchor bolts for equipment placed on concrete bases or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the manufacturer of the equipment.
- E. Concrete equipment bases shall have a minimum height of 4 inches and shall be poured-in-place.

2.10 ACCESS DOORS

- A. Provide access doors in ceilings and walls, where indicated or required for access or maintenance to concealed equipment installed under this section. Provide concealed hinges, screwdriver-type lock, and anchor straps.
- B. Manufactured by Milcor, Zurn, Titus, or equal. Obtain architect's approval of type, size, location and color before ordering.

2.11 EQUIPMENT FURNISHED BY OTHERS

- A. Provide necessary equipment and accessories that are not provided by the equipment supplier or owner to complete installation of equipment furnished by others, in locations as indicated on the drawings, specified herein, or both. Equipment and accessories not provided by the equipment supplier may include such items as flexible cords and plugs, as required for proper operation of the complete system, in accordance with the manufacturers' instructions.
- B. Be responsible for correct rough-in dimensions, and verify them with engineer, owner's representative, equipment supplier, or all three, prior to rough-in and service installations.

2.12 CLEANING

A. In addition to the requirements of Division 1, remove from the premises dirt and refuse resulting from the performance of the electrical work, as required, to prevent accumulation. Cooperate in maintaining reasonably clean premises at all times. Immediately prior to final inspection, make a final cleanup of dirt and refuse resulting from the work. Clean all material and equipment installed under this division. Remove dirt, dust, plaster, stains and foreign matter from all surfaces. Touch up and restore all damaged finishes to their original condition.

2.13 ADJUSTING, ALIGNING AND TESTING

- A. Adjust, align, and test all electrical equipment on this project provided under this division and all electrical equipment furnished by others for installation or wiring under this division, for proper operation.
- B. Test all systems and equipment according to the requirements in NETA ATS (latest edition) and all additional requirements specified in following sections.
- C. Maintain the following on the project premises at all times: a true RMS reading voltmeter, a true RMS reading ammeter, and a megohimmeter insulation resistance tester. Provide test data readings as requested or as required by the engineer.

2.14 EQUIPMENT IDENTIFICATION

- A. Provide equipment identification nameplates:
 - 1. On all panelboards, switches, starters, dimmers, switches in distribution panelboards and switchboards and where indicated on the drawings.
- B. Nameplates:
 - 1. Engraved, contrasting color, three-layer, laminated plastic indicating the name of the equipment, load, or circuit as designated on the drawings and in the specifications:
 - A. Field-applied permanent epoxy adhesive, compatible with the equipment finish.
 - B. Self-adhering, with a permanent, weatherproof adhesive.
 - C. Attached with stainless steel screws and hardware.
 - D. Attachment method shall be acceptable to the manufacturers of the equipment to which the nameplates are being applied.

2. Color: black background with white letters for normal power; red background with white letters for emergency power. Letter height: ½ inch minimum.

2.15 SYSTEM START UP

- A. Prior to starting up the electrical systems:
 - 1. Check all components and devices.
 - 2. Lubricate items accordingly.
 - 3. Tighten screws and bolts for connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486a and UL 486b.
 - 4. Adjust taps on each transformer for rated secondary voltage when the transformer is at minimum load.
 - 5. Check and record building's service entrance voltage, grounding conditions, grounding resistance, and proper phasing.
 - 6. Replace all burned-out lamps and lamps used for temporary construction lighting in permanent light fixtures.
 - 7. After all systems have been inspected and adjusted, confirm all operating features required by the drawings and specifications and make final adjustments as necessary.

PART 3 - EXISTING EQUIPMENT REUSE AND REMOVAL

- A. Remove all existing wiring, light fixtures, exposed conduits and other electrical installations not reused prior to substantial completion of the work.
- B. Existing raceways may be reused if their points of terminations are suitable; if they are clean inside with no evidence of rust or burrs; if free from cracks, flattened sections or sharp bends; and, if suitably located to avoid conflicts with other trades or installations. Carefully "fish" all existing conduits reused under this contract to remove all debris and obstructions, and swab until all moisture is removed.
- C. Cut, patch, and repair where required for new electrical installations, and patch and repair all surface damage resulting from this work. Cut flush with the floor and plug at both ends, raceways stubbed above the floor and not used at substantial completion of the work.
- D. Relocate all existing electrical systems required to be in operation at substantial completion of the contract, if required, as a result of work included under this contract, even if not specifically indicated in the drawings or specifications.

PART 4 - ALTERNATES

A. Provide all work contemplated under the different alternates to include labor, materials, equipment and services necessary for and incidental to the completion of work under each particular alternate. Furnish separate bids for each alternate applicable to contractor's proposal, stating the amount to be added or deducted from the base bid in case the alternate is accepted. Comply with applicable sections of the base specifications for work required by the alternate unless otherwise specified. Refer to the architectural portion of the specification.

END OF SECTION

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Copper building wire rated 600 V or less.
 - 2. Aluminum building wire rated 600 V or less.
 - 3. Metal-clad cable, Type MC, rated 600 V or less.
 - 4. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
 - 4. #10 AWG and smaller shall be solid (not stranded).
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 496 for stranded conductors.
- D. Conductor Insulation:
 - 1. Type NM: Comply with UL 83 and UL 719.
 - 2. Type RHH and Type RHW-2: Comply with UL 44.
 - 3. Type USE-2 and Type SE: Comply with UL 854.
 - 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 - 5. Type THHN and Type THWN-2: Comply with UL 83.
 - 6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 - 7. Type UF: Comply with UL 83 and UL 493.
 - 8. Type XHHW-2: Comply with UL 44.
- E. Shield:
 - 1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

2.2 ALUMINUM BUILDING WIRE

- 1. Allowed only as a cost savings request by the owner.
- 2. Owner shall provide permission in writing (email).
- 3. Contractor shall obtain written permission (email) from local AHJ.
- 4. Do not submit bids with aluminum as basis of install unless approved prior to bid date.

2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath. MC cable shall include grounding conductor.

- B. Shall primarily be used as whips for connections to equipment and lighting not to exceed 6ft in length.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. RoHS compliant.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- G. MC Steel Metal Clad Cable Requirements:
 - 1. MC Steel Metal Clad Cable must have the following:
 - a. Armor: Galvanized interlocking steel strip.
 - b. Conductors: Solid Copper.
 - c. Conductor Insulation: THHN/THWN
 - d. Assembly Covering: Polypropylene Tape
 - e. Maximum Temperature Rating: 90°C (dry)
 - f. Grounding: One grounding means, must be insulated copper conductor.
 - g. Neutral Conductor: White
 - h. Maximum Voltage Rating: 600V
 - i. Rating Compliance with the following:
 - 1) UL® 83, 1479, 1569, 1581, 2556
 - 2) Cable Tray Rated, install per NEC®
 - 3) UL® Classified 1, 2, and 3 hour through (Fire) penetration product, R-14141
 - 4) Environmental Air-Handling Space Installation per NEC® 300.22(C)
 - 2. Do Not Use MC Cable for the Following:
 - a. Homeruns to panelboards.
 - b. Where exposed to view.
 - c. Where exposed to damage.
 - d. Hazardous locations.
 - e. Wet locations.
 - f. When restricted otherwise above, and when specifically disallowed by the local AHJ or Owner.
 - g. Circuits supplied by an emergency or standby power source.

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3. Aluminum sheathing for MC Cable is not allowed.

2.4 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- F. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type XHHW-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- K. Branch Circuits in Cable Tray: Type XHHW-2, single conductors larger than No. 1/0 AWG.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- M. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
 - 2. Push-in style connectors are not allowed.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding critical equipment and services for compliance with requirements.
 - 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.

- b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
- c. Inspect compression-applied connectors for correct cable match and indentation.
- d. Inspect for correct identification.
- e. Inspect cable jacket and condition.
- f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
- g. Continuity test on each conductor and cable.
- h. Uniform resistance of parallel conductors.
- 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Ground rods.
 - 3) Ground rings.
 - 4) Grounding arrangements and connections for separately derived systems.
 - 5) Photos of the grounding rod installation and footing steel connections.
- b. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

- 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tinplated or silicon bronze bolts.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with socket set screw.
- J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- M. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- N. Straps: Solid copper, copper lugs. Rated for 600 A.
- O. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.
- P. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- Q. Water Pipe Clamps:
- 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
- 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.
- C. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

- F. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 FENCE GROUNDING

A. Fence Grounding: Install at maximum intervals of 1000 feet except as follows:

- 1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
 - a. Gates and Other Fence Openings: Ground fence on each side of opening.
 - 1) Bond metal gates to gate posts.
 - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.7 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Installbonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches from building's foundation.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.

- 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.
- L. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.

- 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- F. Grounding system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
 - 5. Substations and Pad-Mounted Equipment: 5 ohms.
 - 6. Manhole Grounds: 10 ohms.
- I. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Nonmetal wireways and auxiliary gutters.
 - 5. Surface raceways.
 - 6. Boxes, enclosures, and cabinets.
 - 7. Handholes and boxes for exterior underground cabling.

1.2 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.3 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- D. Samples: For wireways and surface raceways and for each color and texture specified, 12 inches long.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.

- 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. GRC: Comply with ANSI C80.1 and UL 6.
 - 3. ARC: Comply with ANSI C80.5 and UL 6A.
 - 4. IMC: Comply with ANSI C80.6 and UL 1242.
 - 5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch, minimum.
 - 6. EMT: Comply with ANSI C80.3 and UL 797.
 - 7. FMC: Comply with UL 1; zinc-coated steel.
 - 8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
 - 1. Comply with NEMA FB 1 and UL 514B.
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 5. Fittings for EMT:
 - a. Material: Steel.

- b. Type: Setscrew.
- 6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- 7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Nonmetallic Conduit:
 - 1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Fiberglass:
 - a. Comply with NEMA TC 14.
 - b. Comply with UL 2515 for aboveground raceways.
 - c. Comply with UL 2420 for belowground raceways.
 - 3. ENT: Comply with NEMA TC 13 and UL 1653.
 - 4. RNC: Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
 - 5. LFNC: Comply with UL 1660.
 - 6. Rigid HDPE: Comply with UL 651A.
 - 7. Continuous HDPE: Comply with UL 651A.
 - 8. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
 - 9. RTRC: Comply with UL 2515A and NEMA TC 14.
- B. Nonmetallic Fittings:
 - 1. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.
 - 3. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Hinged type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Prime coated, ready for field painting.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. Tele-Power Poles:
 - 1. Material: Aluminum with clear anodized finish.
 - 2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
 - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- L. Gangable boxes are allowed.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:

- 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
- 2. Hinged door in front cover with flush latch and concealed hinge.
- 3. Key latch to match panelboards.
- 4. Metal barriers to separate wiring of different systems and voltage.
- 5. Accessory feet where required for freestanding equipment.
- 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - 1. Standard: Comply with SCTE 77.
 - 2. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC.".
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of reinforced concrete.
 - 1. Standard: Comply with SCTE 77.
 - 2. Color of Frame and Cover: Gray.
 - 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 6. Cover Legend: Molded lettering, "ELECTRIC.".
 - 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Underground Conduit: RNC, Type EPC-80-PVC,.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: GRC.
 - 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.

- 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
- 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
- 3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
- 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

- K. Support conduit within 12 inches of enclosures to which attached.
- L. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to GRC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.

- 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by NFPA 70.
- Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Z. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

- AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- BB.Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- CC.Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- EE. Locate boxes so that cover or plate will not span different building finishes.
- FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- HH. Set metal floor boxes level and flush with finished floor surface.
- II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Section 312000 "Earth Moving."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

- a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
- b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
- 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
- 7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade. Consult with civil engineer for frost line depth at site location.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260544

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fireresistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.

- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boottype flashing units applied in coordination with roofing work.

- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Paint for identification.
 - 9. Fasteners for labels and signs.

1.2 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 electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be continuous colored insulation.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 5. Color for Neutral: White.
 - 6. Color for Equipment Grounds: Green.
 - 7. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

- D. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- F. Equipment Identification Labels:
 - 1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 - 3. Tag: Type II:
 - a. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Thickness: 12 mils.
 - d. Weight: 36.1 lb/1000 sq. ft..
 - e. Tensile according to ASTM D882: 400 lbf and 11,500 psi.
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

2.7 SIGNS

- A. Baked-Enamel Signs:
 - 1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal Size: 7 by 10 inches.
- B. Metal-Backed Butyrate Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal Size: 10 by 14 inches.
- C. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.
 - 2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.

- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F.
 - 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- M. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- W. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
 - 2. Limit use of underground-line warning tape to direct-buried cables.
 - 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- X. Metal Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.
- Y. Nonmetallic Preprinted Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.
- Z. Write-on Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.
- AA. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

BB.Metal-Backed Butyrate Signs:

- 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

CC.Laminated Acrylic or Melamine Plastic Signs:

- 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- DD. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot maximum intervals.
- D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Vinyl wraparound labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 10-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 15 A and 100 V to Ground: Identify with self-adhesive raceway labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 10-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

- 2. Label shall include circuit number and panel of origin.
- F. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- G. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- K. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- L. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- N. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.
 - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- O. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- P. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- Q. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Selfadhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- R. Arc Flash Warning Labeling: Self-adhesive labels.
- S. Operating Instruction Signs: Self-adhesive labels.
- T. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- U. Equipment Identification Labels:
 - 1. Indoor Equipment: Self-adhesive label.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Substations.
 - h. Emergency system boxes and enclosures.
 - i. Motor-control centers.
 - j. Enclosed switches.
 - k. Enclosed circuit breakers.
 - l. Enclosed controllers.
 - m. Variable-speed controllers.
 - n. Push-button stations.
 - o. Power-transfer equipment.
 - p. Contactors.
 - q. Remote-controlled switches, dimmer modules, and control devices.
 - r. Battery-inverter units.
 - s. Battery racks.
 - t. Power-generating units.
 - u. Monitoring and control equipment.

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END OF SECTION
SECTION 260923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Time switches.
 - 2. Photoelectric switches.
 - 3. Standalone daylight-harvesting switching and dimming controls.
 - 4. Indoor occupancy and vacancy sensors.
 - 5. Switchbox-mounted occupancy sensors.
 - 6. Digital timer light switches.
 - 7. High-bay occupancy sensors.
 - 8. Extreme temperature occupancy sensors.
 - 9. Outdoor motion sensors.
 - 10. Lighting contactors.
 - 11. Emergency shunt relays.
- B. Related Requirements:
 - 1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

- 1. Suspended ceiling components.
- 2. Structural members to which equipment will be attached.
- 3. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Control modules.
- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On manufacturer's website. Provide names, versions, and website addresses for locations of installed software.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 - 2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

A. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

- 1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
- 2. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
- 3. Programs: 24 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
- 4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
- 5. Astronomic Time: All channels.
- 6. Automatic daylight savings time changeover.
- 7. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 ELECTROMECHANICAL DIAL-TIME SWITCHES

- A. Electromechanical-Dial Time Switches: Comply with UL 917.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
 - 3. Astronomic time dial.
 - 4. Eight-Day Program: Uniquely programmable for each weekday and holidays.
 - 5. Skip-a-day mode.
 - 6. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. General Requirements for Sensors:
 - 1. Wall and Ceiling-mounted, solid-state indoor vacancy sensors.
 - 2. Dual technology.
 - 3. Integrated power pack.
 - 4. Hardwired connection to switch and lighting control system.
 - 5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 6. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.

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- 8. Power: Line voltage.
- 9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
- 10. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
- 12. Bypass Switch: Override the "on" function in case of sensor failure.
- 13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- B. Dual-Technology Type: Wall and Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Separate for each sensing technology.
 - 2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 - 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180degree pattern centered on the sensor over an area of 1000 square feet when mounted48 inches above finished floor.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, with provisions for connection to BAS using hardwired connection.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24 (only for projects in CA).
 - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 - 4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

2.5 HIGH-BAY OCCUPANCY SENSORS

- A. Description: Solid-state unit. The unit is designed to operate with the lamp and ballasts indicated.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.
 - 3. Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.
 - 4. Power: Line voltage.
 - 5. Operating Ambient Conditions: 32 to 149 deg F.
 - 6. Mounting: Threaded pipe.
 - 7. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 8. Detector Technology: PIR.
 - 9. Power and dimming control from the luminaire ballast that has been modified to include the dimming capacitor.
- B. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.
- C. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.

2.6 EXTREME-TEMPERATURE OCCUPANCY SENSORS

- A. Description: Ceiling-mounted, solid-state, extreme-temperature occupancy sensors with a separate power pack.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application in damp locations.
 - 2. Operation: Turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
 - 3. Operating Ambient Conditions: From minus 40 to plus 125 deg F.
 - 4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 - 5. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 - 6. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind cover.
 - 7. Bypass Switch: Override the "on" function in case of sensor failure.

- 8. Automatic Light-Level Sensor: Adjustable from 2 to 10 fc; keep lighting off when selected lighting level is present.
- B. Detector Technology: PIR. Ceiling mounted; detect occupants in coverage area by their heat and movement.
 - 1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
 - 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1500 sq. ft. when mounted on a 96-inch-high ceiling.
 - 3. Detection Coverage (High Bay): Detect occupancy within 25 feet when mounted on a 25foot-high ceiling.

2.7 OUTDOOR MOTION SENSORS

- A. Description: Solid-state outdoor motion sensors.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 - 2. Dual-technology (PIR and ultrasonic) type, weatherproof. Detect occurrences of 6-inchminimum movement of any portion of a human body that presents a target of not less than 36 sq. in.. Comply with UL 773A.
 - 3. Voltage: Dual voltage, 120- and 277-V type.
 - 4. Detector Coverage:
 - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
 - b. Long Range: 180-degree field of view and 110-foot detection range.
 - 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 - 6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 - 7. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
 - 8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
 - 9. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.8 LIGHTING CONTACTORS

- A. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.9 EMERGENCY SHUNT RELAY

- A. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
 - 1. Coil Rating: 120 V.

2.10 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

- A. Comply with NECA 1.
- B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structureborne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

- 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Lighting control devices will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.8 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.9 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 262726

WIRING DEVICES

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. Straight-blade convenience, hospital-grade, isolated-ground, and tamper-resistant receptacles.
 - 2. USB charger devices.
 - 3. GFCI receptacles.
 - 4. SPD receptacles.
 - 5. Hazardous (classified) location receptacles.
 - 6. Twist-locking receptacles.
 - 7. Pendant cord-connector devices.
 - 8. Cord and plug sets.
 - 9. Toggle switches.
 - 10. Decorator-style convenience.
 - 11. Wall switch sensor light switches with dual technology sensors.
 - 12. Wall switch sensor light switches with passive infrared sensors.
 - 13. Wall switch sensor light switches with ultrasonic sensors.
 - 14. Digital timer light switches.
 - 15. Residential devices.
 - 16. Wall-box dimmers.
 - 17. Wall plates.
 - 18. Floor service outlets.
 - 19. Poke-through assemblies.
 - 20. Prefabricated multioutlet assemblies.
 - 21. Service poles.

1.3 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:
 - 1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
 - 2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
 - 3. Leviton: Leviton Mfg. Company, Inc.
 - 4. Pass & Seymour: Pass& Seymour/Legrand.

- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.
- H. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packinglabel warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.

- D. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
- B. Hospital-Grade, Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
 - 1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
- C. Isolated-Ground, Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- D. Tamper-Resistant Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Description: Labeled and complying with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 USB CHARGER DEVICES

- A. Tamper-Resistant, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.
 - 1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
 - 2. USB Receptacles: Quad, Type A.
 - 3. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.
- B. Hospital-Grade, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL 1310, and FS W-C-596.
 - 1. Description: Labeled and complying with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

2.4 GFCI RECEPTACLES

- A. General Description:
 - 1. 125 V, 20 A, straight blade, feed-through type, self-test type.
 - 2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles:
 - 1. All 15A and 20A, 125V and 250V non-locking receptacles shall be listed as "Weather Resistant" type in Damp and wet locations.
- C. Tamper-Resistant, Duplex GFCI Convenience Receptacles:
- D. Hospital-Grade, Duplex GFCI Convenience Receptacles: Comply with UL 498 Supplement sd.

2.5 SPD RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1449, and FS W-C-596, with integral SPD in line to ground, line to neutral, and neutral to ground.
 - 1. 125 V, 20 A, straight-blade type.
 - 2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
 - 3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
- B. Duplex SPD Convenience Receptacles:
- C. Isolated-Ground, Duplex SPD Convenience Receptacles:
 - 1. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- D. Hospital-Grade, Duplex SPD Convenience Receptacles: Comply with UL 498 Supplement sd.
- E. Isolated-Ground Hospital-Grade Duplex SPD Convenience Receptacles: Comply with UL 498 Supplement sd.

1. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Hazardous (Classified) Locations Receptacles: Comply with NEMA FB 11 and UL 1010.

2.7 TWIST-LOCKING RECEPTACLES

- A. Twist-Lock, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
- B. Twist-Lock, Isolated-Ground, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
 - 1. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.8 PENDANT CORD-CONNECTOR DEVICES

A. Description:

- 1. Matching, locking-type plug and receptacle body connector.
- 2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
- 3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
- 4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.9 CORD AND PLUG SETS

- A. Description:
 - 1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with greeninsulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
 - 3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.10 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

- B. Switches, 120/277 V, 20 A:
- C. Key-Operated Switches: 120/277 V, 20 A.
 - 1. Description: Single pole, with factory-supplied key in lieu of switch handle.
- D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.
- E. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.11 **RESIDENTIAL DEVICES**

- A. Residential-Grade, Tamper-Resistant Convenience Receptacles: 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
 - 1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.
- B. Weather-Resistant and Tamper-Resistant Convenience Receptacles: 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
 - 1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.
- C. Fan-Speed Controls:
 - 1. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters.
 - 2. Comply with UL 1917.
 - 3. Continuously adjustable rotary knob.
- D. Telephone Outlet:
 - 1. Description: Single RJ-45 jack for terminating Category 5e, twisted pair cable.
 - 2. Comply with UL 1863.
- E. Combination TV and Telephone Outlet:
 - 1. Description: Single RJ-45 jack for terminating Category 5e, twisted pair cable and a single BNC connector for terminating coaxial cable.
 - 2. Comply with UL 1863.

2.12 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 - 1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
- E. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.13 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Color determined by architect.
 - 3. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
 - 4. Material for Unfinished Spaces: Galvanized steel.
 - 5. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weatherresistant, die-cast aluminum with lockable cover.

2.14 POKE-THROUGH ASSEMBLIES

- A. Description:
 - 1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
 - 2. Comply with UL 514 scrub water exclusion requirements.
 - 3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."
 - 4. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
 - 5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

- 6. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
- Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

2.15 WALL MOUNTED TV LOCATIONS

- A. Where wall mounted TVs are indication in the plans provide the following:
 - 1. All-in-one power and AV recessed box similar to Legrand Evolution Series.
 - 2. Box shall include one duplex outlet, one coax cable, and one CAT6 cable.
 - 3. Provide all accessories for a complete finish.
 - 4. Boxes shall have a white finish

2.16 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. SPD Devices: Blue.
 - 4. Isolated-Ground Receptacles: Orange.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:

- 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
- 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
- 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device.
 - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold devicemounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
 - 2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
 - 1. Install dimmers within terms of their listing.
 - 2. Verify that dimmers used for fan-speed control are listed for that application.
 - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 - 2. Test Instruments: Use instruments that comply with UL 1436.
 - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..
- F. Wiring device will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

- 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600-V ac.
 - 4. 1200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating 120-V ac.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.

2.4 NONFUSIBLE SWITCHES

- A. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

- 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
- 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
- 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
- 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating 120-V ac.
- 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
- 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
- 8. Service-Rated Switches: Labeled for use as service equipment.

2.5 RECEPTACLE SWITCHES

- A. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, 30A, 60A, or 100 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- B. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
- C. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating 120-V ac.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.

2.6 SHUNT TRIP SWITCHES

- A. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.
- B. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, 30A, 60A, 100 A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads

to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 600-V ac, 30A, 60A, 100 A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power source of enough capacity to operate shunt trip, pilot, indicating and control devices.
- E. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight red ON pilot light.
 - 3. Isolated neutral lug; 200 percent rating.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
 - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
 - 8. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 9. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 - 10. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 11. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating 120-V ac.
 - 12. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 13. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 14. Service-Rated Switches: Labeled for use as service equipment.

2.7 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.
- D. MCCBs shall be equipped with a device for locking in the isolated position.

- E. Lugs shall be suitable for 167 deg F rated wire.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- N. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - Communication Capability: Circuit-breaker-mounted Integral communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
 - 6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuitbreaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

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- 9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
- 10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- 11. Electrical Operator: Provide remote control for on, off, and reset operations.
- 12. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.8 MOLDED-CASE SWITCHES

- A. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- B. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- C. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs:
 - a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - b. Lugs shall be suitable for 167 deg F rated wire.
 - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
 - 7. Alarm Switch: One NO contact that operates only when switch has tripped.
 - 8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
 - 9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
 - 10. Electrical Operator: Provide remote control for on, off, and reset operations.
 - 11. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.9 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.

- 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
- 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
- 6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 with cover attached by Type 316 stainless steel bolts.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.

- f. Verify that each fuse has adequate mechanical support and contact integrity.
- g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
- 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- D. Tests and Inspections for Molded Case Circuit Breakers:
 - 1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.

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- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.
- 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

- 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
- Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
- 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
- f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
- g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
- h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
- i. Verify operation of charging mechanism. Investigate units that do not function as designed.
- 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION

SECTION 265119

LED INTERIOR LIGHTING

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 the following types of LED luminaires:
 - 1. Cylinder.
 - 2. Downlight.
 - 3. Highbay, linear.
 - 4. Linear industrial.
 - 5. Lowbay.
 - 6. Parking garage.
 - 7. Recessed linear.
 - 8. Strip light.
 - 9. Surface mount, linear.
 - 10. Surface mount, nonlinear.
 - 11. Suspended, linear.
 - 12. Suspended, nonlinear.
 - 13. Materials.
 - 14. Finishes.
 - 15. Luminaire support.
- B. Related Requirements:
 - 1. Section 260923"Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.

- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
- D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
 - 1. Include Samples of luminaires and accessories involving color and finish selection.
- E. Samples for Verification: For each type of luminaire.
 - 1. Include Samples of luminaires and accessories to verify finish selection.
- F. Product Schedule: For luminaires and lamps.
1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Suspended ceiling components.
 - 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 - 4. Structural members to which equipment and or luminaires will be attached.
 - 5. Initial access modules for acoustical tile, including size and locations.
 - 6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.
 - 7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of luminaire.
- F. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Standards:
 - 1. ENERGY STAR certified.
 - 2. California Title 24 compliant.
 - 3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
 - 4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
 - 5. UL Listing: Listed for damp location.
 - 6. Recessed luminaires shall comply with NEMA LE 4.
 - 7. User Replaceable Lamps:
 - a. Bulb shape complying with ANSI C78.79.
 - b. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- C. CRI of minimum of 80. CCT as specified on drawings.
- D. Rated lamp life of 50,000 hours to L90.
- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- F. Internal driver.
- G. Nominal Operating Voltage: 120 V ac.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- H. Housings:

- 1. Extruded-aluminum housing and heat sink.
- 2. Powder-coat finish.

2.3 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:

- 1. Attached to structural members in walls.
- 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
 - 2. Ceiling mount with pendant mount
 - 3. Ceiling mount with hook mount.
- H. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
 - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within **12** months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 265619

LED EXTERIOR LIGHTING

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. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
 - 2. Luminaire supports.
 - 3. Luminaire-mounted photoelectric relays.
- B. Related Requirements:
 - 1. Section 260923"Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Arrange in order of luminaire designation.

- 2. Include data on features, accessories, and finishes.
- 3. Include physical description and dimensions of luminaire.
- 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
- 5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 IES LM-80.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- 6. Wiring diagrams for power, control, and signal wiring.
- 7. Photoelectric relays.
- 8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.
- D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- E. Delegated-Design Submittal: For luminaire supports.
 - 1. Include design calculations for luminaire supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Structural members to which equipment and luminaires will be attached.
 - 3. Underground utilities and structures.
 - 4. Existing underground utilities and structures.
 - 5. Above-grade utilities and structures.
 - 6. Existing above-grade utilities and structures.
 - 7. Building features.
 - 8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.

- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of the following:
 - 1. Luminaire.
 - 2. Photoelectric relay.
- E. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- F. Source quality-control reports.
- G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as

defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- F. Mockups: For exterior luminaires, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of 80. CCT as specified on drawings.
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac or 208 V ac.
- L. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- M. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- N. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.4 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:

- a. "USE ONLY" and include specific lamp type.
- b. Lamp diameter, shape, size, wattage and coating.
- c. CCT and CRI for all luminaires.

2.5 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: Verify with Architect.
- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of manufacturer's standard or custom color.
 - c. Color: As selected by Architect from manufacturer's full range.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:

- 1. Attached to structural members in walls.
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 BOLLARD LUMINAIRE INSTALLATION:

- A. Align units for optimum directional alignment of light distribution.
 - 1. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.6 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.10 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 312000

EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating and filling for rough grading the Site.
 - 2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
 - 3. Excavating and backfilling for buildings and structures.
 - 4. Drainage course for concrete slabs-on-grade.
 - 5. Subbase course for concrete pavements.
 - 6. Subbase course and base course for asphalt paving.
 - 7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.2 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 INFORMATIONAL SUBMITTALS

A. Material test reports.

1.4 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1. Liquid Limit: 40 or less.
 - 2. Plasticity Index: 7 to 18.
 - 3. Containing at least 15 percent fines (material passing the standard US No. 200 sieve, based on dry weight).
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

- D. Subbase Material: Off-site low plasticity cohesive soil having a plasticity index (PI) of 8 to18, containing at least 15% fines (material passing the No. 200 sieve, based on dry weight), and classifying as clayey sand (SC) or lean clay (CL). ODOT Type "A" aggregate base can also be used as Subbase Material.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve. ODOT Type "A" aggregate base is an acceptable Base Course material.
- F. Engineered Fill: Off-site low plasticity cohesive soil having a plasticity index (PI) of 8 to18, containing at least 15% fines (material passing the No. 200 sieve, based on dry weight), and classifying as clayey sand (SC) or lean clay (CL). ODOT Type "A" aggregate base can also be used as Engineered Fill.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Excavations for Slabs on Grade: Excavate 18 inches below the bottom of the slab for placement of acceptable Subbase Material and Base Course.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

- 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
 - 3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 SUBGRADE INSPECTION

- A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- E. Initial Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, for 6 inches under building slabs, use Base Course; for 24 inches below Base Course, use Subbase Material.
 - 5. Under footings and foundations, use subbase material if needed to replace unsuitable soil.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

- 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
- 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

- 1. Shape subbase course and base course to required crown elevations and cross-slope grades.
- 2. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
- 3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.15 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-ongrade as follows:
 - 1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 329200

TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sodding.

1.2 DEFINITIONS

A. Planting Soil: Existing, on-site soil.

1.3 INFORMATIONAL SUBMITTALS

- A. Certification of grass seed.
 - 1. Certification of each seed mixture for turfgrass sod.
- B. Product certificates.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
- B. Provide turf maintenance as listed under Execution section for a period of 60 days.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

- A. Turfgrass Sod, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Sod of grass species as follows:
 - 1. Full Sun: "U-3" Bermuda Grass.

2.2 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 4 lb/1000 sq. ft. 10 percent of actual nitrogen, 20 percent phosphorous, and 10 percent potassium, by weight.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

- A. Reduce elevation of planting soil to allow for soil thickness of sod.
- B. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.3 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings.

3.4 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, evencolored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

END OF SECTION