



**Galen College of Nursing
Panama City Beach Campus
Project Manual**

**200 RICHARD JACKSON BLVD.
PANAMA CITY BEACH, FL 32407**

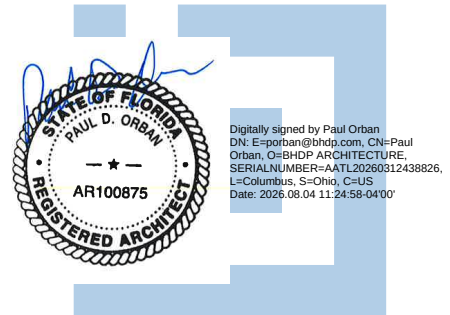
**July 31, 2026
BHDP No. GCN01.82**

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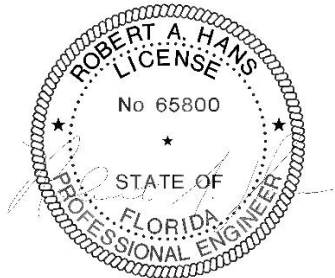
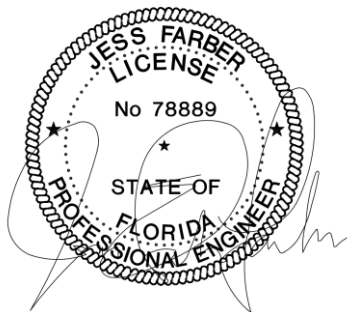
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DESIGN PROFESSIONALS OF RECORD

- A. Architect:
 - 1. BHDP Architecture
 - a. Corporate License Information: AA0002664
 - 2. Paul D. Orban
 - a. Florida License No. AR100875
- B. Fire Protection Engineer:
 - 1. Jess Farber, CMTA, INC.
 - 2. Florida License No. 78889
- C. Plumbing Engineer:
 - 1. Jess Farber, CMTA, INC.
 - 2. Florida License No. 78889
- D. Mechanical Engineer:
 - 1. Jess Farber, CMTA, INC.
 - 2. Florida License No. 78889
- E. Electrical Engineer:
 - 1. James Messner, CMTA, INC.
 - 2. Florida License No. 89528



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DOCUMENT 00 2600
PROCUREMENT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids in accordance with Instructions to Bidders.
- B. Procurement Prior Approval Requests: Requests for approval of products or manufacturers from those required by the Contract Documents as defined by product selection procedures in Section 016000 "Product Requirements."
 - 1. Procurement prior approval is required when products or manufacturers are listed in specifications under "Sole Product," "Sole Manufacturer," "Limited List of Products," or "Limited List of Manufacturers" introductory paragraphs.
 - 2. Procurement prior approval is not required when products or manufacturers are listed in specifications under "Non-Limited List of Products" or "Non-Limited List of Manufacturers" introductory paragraphs.
 - 3. Where use of "Sole Product," "Sole Manufacturer," "Limited List of Products," or "Limited List of Manufacturers" introductory paragraphs is not allowed by statute, procurement prior approval request is not required.
- C. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See the General Conditions and Section 012500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

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

1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:

1. Extensive revisions to the Contract Documents are not required.
2. Proposed changes are in keeping with general intent of the Contract Documents, including level of quality of the Work represented by requirements therein.
3. Request is fully documented and properly submitted.

1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing by prime contract Bidder only in compliance with the following requirements:
 1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
 2. Submittal Format, Printed: Submit one electronic copy of each written Procurement Substitution Request, using form bound in Project Manual .
- B. Architect's Action:
 1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all Bidders of acceptance of proposed substitute by means of an Addendum to the Procurement and Contracting Documents.
- C. Architect's approval of substitute during bidding does not relieve Contractor of the responsibility to submit required Shop Drawings and to comply with all other requirements of the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 00 2600

DOCUMENT 00 2601
REQUEST FOR SUBSTITUTION FORM, BIDDING PHASE

PART 1 - GENERAL

1.1 SUMMARY

- A. Prime Bidders: Use this form to request consideration of an unnamed manufacturer, an unnamed product, or an alternative fabrication method prior to submittal of bids when use of specific manufacturers, products, or fabrications methods are required by the Specifications.
- B. See Document 002600 "Procurement Substitution Procedures" for instructions for submittal of this form and for definitions used on this form.
- C. This form is not required to be submitted when named products are introduced by the phrase "Available products include..." unless the intended product differs substantially from the requirements of the Contract Documents.
- D. Response to this request by Architect will be in the form of a written response to the Bidder and, if approved, by Addendum issued to all Bidders.

1.2 PROJECT INFORMATION

- A. Project Name: Panama City Beach Campus
- B. Project Location: Panama City Beach, Florida
- C. Owner: Galen College of Nursing.
- D. Architect: BHDP Architecture.
- E. Architect Project Number: GCN08.21.

1.3 BIDDING REQUEST INFORMATION

- A. Bidder: _____. Email: _____.
- B. Specification Section No.: _____.

1.4 SPECIFIED PRODUCT

- A. Specified Product/Fabrication Method (List Name, Description, Model Number, and Manufacturer): _____.
- B. Specified Product Information (Attach Point-by-Point Data to This Form):
 - 1. ☐ Point-by-point comparative product data.
 - 2. ☐ Test reports.
 - 3. ☐ Fabrication drawings.
 - 4. ☐ Samples (where applicable).

1.5 PROPOSED PRODUCT

- A. Specified Product/Fabrication Method (List Name, Description, Model Number, and Manufacturer): _____.
- B. Proposed Product Information (Attach Point-by-Point Data to This Form):
1. ☐ Point-by-point comparative product data.
 2. ☐ Test reports.
 3. ☐ Fabrication drawings.
 4. ☐ Samples (where applicable).

1.6 IMPACT OF PROPOSED SUBSTITUTION

- A. List of Related Changes Required by Substitution: ☐ None. Explain: _____.
- B. Differences between Specified Product and Proposed Substitution: ☐ None. Explain: _____.
- C. Proposed Product/Fabrication Method Effects on Other Parts of the Work: ☐ None. Explain: _____.
- D. Proposed Product/Fabrication Method Effects on the Contract Time: ☐ None. Explain: _____.

1.7 CERTIFICATION

- A. Undersigned certifies the following:
1. Proposed substitution has been investigated by the Bidder and determined to be equal or superior to specified product as used for this Project, except as noted herein.
 2. Qualifications of manufacturer, Installer, and other specified parties meet the specified qualifications.
 3. Same warranty will be furnished for proposed substitution as for specified product, if applicable.
 4. Same maintenance service and availability of replacement parts as for specified product, if applicable.
 5. Proposed substitution does not affect dimensions and functional clearances, except as noted herein.
 6. Proposed substitution will not affect the Contract Time.
 7. Proposed substitution will not affect work of other trades.
 8. Proposed substitution provides comparable sustainable design properties as specified product, if applicable.

1.8 SUBMISSION OF REQUEST FOR SUBSTITUTION

- A. For the Bidder:
1. Submittal Date: _____.
 2. Firm Name: _____.

3. Submitted by: _____.
4. Email: _____.

B. For Manufacturer:

1. Submittal Date: _____.
2. Firm Name: _____.
3. Submitted by: _____.
4. Email: _____.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 00 2601

DOCUMENT 00 6325
REQUEST FOR SUBSTITUTION FORM, CONSTRUCTION PHASE

PART 1 - GENERAL

1.1 SUMMARY

- A. Contractor: Utilize this form to request consideration of an unnamed manufacturer, product, or specified fabrication method prior to commencing submittal preparation when use of specific manufacturers, products, or fabrication methods are required by the specifications.
- B. Refer to Section 012500 "Substitution Procedures" for instructions for submittal of this form and for definitions used on this form.
- C. This form is not required to be submitted when named products are introduced by the phrase "Available products include ..." unless the intended product differs substantially from the requirements of the Contract Documents.
- D. Response to this request by the Architect will be in the form of a written Modification or other document as described in the Contract Documents.

1.2 PROJECT INFORMATION

- A. Project Name: Panama City Beach Campus
- B. Project Location: Panama City Beach, Florida
- C. Owner: Galen College of Nursing.
- D. Architect: BHDP Architecture.
- E. Architect Project Number: GCN08.21.

1.3 REQUEST INFORMATION

- A. Specification Section and Paragraph No.: _____.
- B. Drawing Sheet/Detail Number: _____.

1.4 REQUEST FOR SUBSTITUTION

- A. Substitution for Cause: Indicate reason for request:
 - 1. ☐ Specified product not available within Project schedule.
 - 2. ☐ Specified product not compatible with other approved products.
 - 3. ☐ Specified warranty not available.
- B. Substitution for Convenience:
 - 1. Not allowed.

1.5 SPECIFIED PRODUCT

- A. Specified Product/Fabrication Method (List name, description, model number, manufacturer):
_____.
- B. Specified Product Information (Note attached):

1.6 PROPOSED PRODUCT

- A. Specified Product/Fabrication Method (List name, description, model number, manufacturer):
_____.
- B. Proposed Product Information (Note required point-by-point comparative data, to be attached to this form):
1. ☐ Point-by-point comparative product data
 2. ☐ Test reports
 3. ☐ Fabrication drawings
 4. ☐ Samples (where applicable)

1.7 IMPACT OF PROPOSED SUBSTITUTION

- A. List of related changes to the Work required by substitution: ☐ None. Explain:
_____.
- B. Differences between specified product and proposed substitution: ☐ None. Explain:
_____.
- C. Proposed product/fabrication method effects on other parts of the Work: ☐ None. Explain: _____.
- D. Proposed product/fabrication method effects on Contract Time: ☐ None. Explain:
_____.
- E. Proposed product/fabrication method effects on Contract Sum: ☐ None. Explain:
_____.

1.8 CERTIFICATION

- A. Undersigned certifies that:
1. Proposed substitution has been investigated by Contractor who has determined it to be equal or superior to specified product, except as noted herein.
 2. Qualifications of manufacturer, installer, and other specified parties meet the specified qualifications.
 3. Same warranty will be furnished for proposed substitution as for specified product, if applicable, except as noted herein.
 4. Same maintenance service and availability of replacement parts as for specified product, if applicable.
 5. Proposed substitution does not affect dimensions and functional clearances, except as noted herein.

6. Proposed substitution will not affect Contract Time, except as noted herein.
7. Proposed substitution will not affect work of other trades, except as noted herein.
8. Proposed substitution provides comparable sustainable design properties as specified product, if applicable.

1.9 SUBMISSION OF REQUEST FOR SUBSTITUTION

A. For the Contractor:

1. Submittal date: _____.
2. Firm name: _____.
3. Submitted by: _____.
4. Email: _____.

1.10 ARCHITECT'S ACTION

- A. Architect's response to Request for Substitution will be as described in Section 012500 "Substitution Procedures."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 00 6325

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Owner-furnished/Contractor-installed (OFCI) products.
6. Owner-furnished/Owner-installed (OFOL) products.
7. Contractor's use of site and premises.
8. Coordination with occupants.
9. Work restrictions.
10. Specification and Drawing conventions.
11. Miscellaneous provisions.

B. Related Requirements:

1. Section 017300 "Execution" for coordination of Owner-installed products.

1.2 PROJECT INFORMATION

A. Project Identification: Galen – Panama City Beach Campus

1. Project Location: Panama City Beach, Florida

B. Owner: Galen College of Nursing

1. Owner's Representative: Ron Howard – rhoward@galencollege.edu

C. Architect: BHDP Architecture

1. Architect's Representative: Jessica Schmidt - jschmidt@bhdp.com.

D. Engineer: CMTA

1. Engineer's Representative: David Finke - dfinke@cmta.com

E. Construction Manager for this Project is Project's constructor. The terms "Construction Manager" and "Contractor" are synonymous.

F. Web-Based Project Software: Project software will be used for purposes of managing

communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
 1. Controls upgrade and valve replacement at Mantei and other Work indicated in the Contract Documents.
- B. Type of Contract:
 1. Project will be constructed under a single prime contract.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.5 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner/Tenant will occupy portions of the Project site and existing building(s) during entire construction period. Cooperate with Owner/Tenant and Landlord during construction operations to minimize conflicts and facilitate Owner/Tenant usage. Perform the Work so as not to interfere with Owner's and Tenant's day-to-day operations. Maintain existing exits unless otherwise indicated.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.6 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7am a.m. to 7pm, Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 1. Weekend Hours: Coordinate with building owner
 2. Early Morning Hours: Coordinate with building owner
 3. Hours for Utility Shutdowns: Provide 72 hour notice to building owner
- 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 arranging for temporary utility services according to requirements indicated:
 1. Notify Owner not less than three days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 1. Maintain list of approved screened personnel with Owner's representative.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including

General and Supplementary Conditions, apply to all Sections of the Specifications.

- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012000 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A Procedures for preparation and submittal of applications for progress payments.
- B Documentation of changes in Contract Sum and Contract Time.
- C Contract modification procedures.
- D Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES

- A Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B Format and Content: Use Project Manual Table of Contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

- 1) Labor.
- 2) Materials.
- 3) Equipment.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
5. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
6. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
7. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
8. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
9. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
10. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.03 APPLICATIONS FOR PAYMENTS

- A Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B Payment Application Times: Submit Application for Payment to Architect by the last business day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

- C Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 - 1. Other Application for Payment forms proposed by the Contractor shall be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- D Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F Transmittal: Submit a PDF signed and notarized original copies of each Application for Payment to Architect. Include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

- G Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Sustainable design action plans, including preliminary project materials cost data.
 7. Schedule of unit prices.
 8. Submittal schedule (preliminary if not final).
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.
 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Initial progress report.
 14. Report of preconstruction conference.
 15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.
 18. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

19. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706.
5. AIA Document G706A.
6. AIA Document G707.
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

1.04 MINOR CHANGES IN THE WORK

A Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on Architect's Architectural Supplemental Instructions Form.

1.05 PROPOSAL REQUESTS

A Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

- c. Include costs of labor and supervision directly attributable to the change.
- 3. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - a. Quotation Form: Use forms acceptable to Architect.
- B Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Architect.

1.06 CHANGE ORDER PROCEDURES

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

1.07 CONSTRUCTION CHANGE DIRECTIVE

- A Construction Change Directive: Architect may issue a Construction Change Directive with Owner's written approval. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012000

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 Part 3 "Schedule of Alternates" Article 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. Alternate No. **001** – Public access corridor finish refresh

1. Base Bid: Demolish South lobby flooring, base, welcome desk, and northern most office. Replace ceiling with new acoustic suspended ceiling system and fixtures per A111. Paint & replace base on only new walls. Replace corner guards throughout entire corridor space.
2. Alternate: Replace ceilings, flooring, & base throughout entire public access corridor from south entrance to north entrance including corridor between existing to remain shipping / receiving & the building electrical room. Remove existing security mirrors, patch and paint walls. Paint the entire public access corridor.

B. Alternate No. **002** – Aluminum Frame glass wall system

1. Base Bid: Interior glazed wall systems to be provided by Demountable partition manufacturer. See Specification Section 102219 – Demountable Partitions for basis of design
2. Alternate: Interior glazed wall systems to be provided by 'WilsonPartitions' as aluminum framed glazed partitions with Wilson Series 2400 4-7/8 Interior Aluminum Systems as the basis of design.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. Section 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.
 - 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: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable

Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 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.

1.5 PROCEDURES

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

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience:
 - 1. Not allowed unless otherwise indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on web-based Project management software.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 15 days, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Owner and Architect.

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

1.4 CHANGE ORDER PROCEDURES

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

1.5 CONSTRUCTION CHANGE DIRECTIVE

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

1.6 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Architect may issue a Work Change Directive on EJCDC Document C-940. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Web-based Project management software package.
 - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 2. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Construction Manager, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.

Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

- c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
- d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
- e. Indicate required installation sequences.
- f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

- 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
- 2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
- 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
- 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
- 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
- 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
- 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center

lines.

8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using PDF format.
 3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.

3. Owner's Project number.
 4. Name of Architect.
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow three days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect or Construction Manager of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time

or the Contract Sum, notify Architect and Construction Manager in writing within 5 > days of receipt of the RFI response.

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project management software. Include the following: Software log with not less than the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect and Construction Manager.
 - 4. RFI number, including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's and Construction Manager's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.7 PROJECT MEETINGS

- A. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
 - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.

- l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUMMARY

- A Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.

1.02 DEFINITIONS

- A Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E Event: The starting or ending point of an activity.

1.03 INFORMATIONAL SUBMITTALS

- A Format for Submittals: Submit required submittals in the following format:

1. PDF file.
- B Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- C Construction Schedule Updating Reports: Submit with Applications for Payment.
- D Site Condition Reports: Submit at time of discovery of differing conditions.
- E Unusual Event Reports: Submit at time of unusual event.
- F Qualification Data: For scheduling consultant.

1.04 QUALITY ASSURANCE

- A Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 1. Review software limitations and content and format for reports.
 2. Verify availability of qualified personnel needed to develop and update schedule.
 3. Discuss constraints, including work stages.
 4. Review delivery dates for Owner-furnished products.
 5. Review schedule for work of Owner's separate contracts.
 6. Review submittal requirements and procedures.
 7. Review time required for review of submittals and resubmittals.
 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 9. Review time required for Project closeout and Owner startup procedures.
 10. Review and finalize list of construction activities to be included in schedule.
 11. Review procedures for updating schedule.

1.05 COORDINATION

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

1.06 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
 - 1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
- C Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- D Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 - 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 - 5. Commissioning Time: Include no fewer than days for commissioning.
 - 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- E Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work under More Than One Contract: Include a separate activity for each contract.

3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Limitations of continued occupancies.
 - b. Uninterruptible services.
 - c. Partial occupancy before Substantial Completion.
 - d. Use-of-premises restrictions.
 - e. Provisions for future construction.
 - f. Seasonal variations.
 - g. Environmental control.
7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.

f. Substantial Completion.

- F Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- G Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
 - 1. See Section 01 20 00 "Price and Payment Procedures" for cost reporting and payment procedures.
- H Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. 1. Unresolved issues.
 - 2. 2. Unanswered Requests for Information.
 - 3. 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- I Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate final completion percentage for each activity.
- J Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 STARTUP CONSTRUCTION SCHEDULE

- A Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for commencement of the Work.
- B Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

3.02 GANTT-CHART SCHEDULE REQUIREMENTS

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

3.03 CPM SCHEDULE REQUIREMENTS

- A General: Prepare network diagrams using AON (activity-on-node) format.

- B Startup Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and final completion.
 - l. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Event: The starting or ending point of an activity.
- E Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H Insert articles for other schedules and lists to suit Project, depending on complexity.

3.04 REPORTS

- A Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. Construction Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Partial completions and occupancies.
 20. Substantial Completions authorized.
- B Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager'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."

1.3 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 Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

- a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's and Construction Manager's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Construction Manager.
 5. Name of Contractor.
 6. Name of firm or entity that prepared submittal.
 7. Names of subcontractor, manufacturer, and supplier.
 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 9. Category and type of submittal.
 10. Submittal purpose and description.
 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 12. Drawing number and detail references, as appropriate.
 13. Indication of full or partial submittal.
 14. Location(s) where product is to be installed, as appropriate.
 15. Other necessary identification.
 16. Remarks.
 17. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- 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 Architect and Construction Manager on previous submittals. Indicate by highlighting on

each submittal or noting on attached separate sheet.

- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 - 2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. 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.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect and

- Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's and Construction Manager's action stamp.
- E. 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.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

1.6 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 concurrently 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.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
- C. Samples: Submit Samples for review of type, 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. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
 6. 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.
7. 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. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
8. 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. Architect and Construction Manager will retain two 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:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- 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. 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.
 - 2. 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.
 - 3. 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.
 - 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
 - 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 - 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
 - 1. 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 substrate preparation and primers required.
 - 2. 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.
 - 3. 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.
 - 4. 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.
 - 5. 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.

6. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 01 33 33
DATA TRANSFER AGREEMENT AND DISCLAIMER

In consideration of the transfer of certain data, including electronic and/or digital information, by Baxter Hodell Donnelly Preston, Inc. dba BHDP Architecture (BHDP) to the Recipient identified below, for the Project and Purpose identified below, the Recipient agrees and acknowledges the following:

Recipient: _____

Project: _____

Limited Purpose: _____

1. Any and all plans, drawings, other documents, including electronic/digital files, data, meta data prepared or furnished at any time by BHDP (referred to herein as "data") are instruments of service, and BHDP shall retain all ownership and property interests.
2. The transfer of data by BHDP for the express and limited Purpose described above does not grant to Recipient an assignment of any right or interest in these data, or in any software or process utilized to develop these data.
3. BHDP makes no representation as to the compatibility of these data with any hardware or software.
4. These data and any information contained in any medium including any electronic or digital file are proprietary, and Recipient will not use or copy the information for use on any other project or for any other purpose. Though the information may not bear a copyright symbol, Recipient understands that BHDP is the author and/or owner of these data and agrees that BHDP will be entitled to statutory and other damages, including attorneys' fees for any use of these data, except for the limited Purpose described herein above.
5. The Recipient shall not make or permit to be made any copies or any modification to these data and shall not be permitted to assign or transfer any rights Recipient may have under this Agreement, including transfer or assignment of notes, payments or damages related to this Agreement or the data.
6. The Recipient shall not rely upon, attribute, reference and/or publish, in any form or manner, BHDP's name, seal, or any identifying indicia thereof, which may confuse the market, channel, industry, and/or jurisdiction without BHDP's express written consent.
7. The transfer of these data shall not in any way obviate the architect, engineer or designer of record's requirement, or any contractor's responsibility, to properly review, administer and exercise responsible control and charge over these data and to fully coordinate these data, as may be required for Recipient's intended or actual use or obligation.
8. The Recipient may make and retain copies for information and reference in connection with the Project identified herein above for the limited Purpose identified herein above; however, such documents are not intended or represented to be suitable for use by the Recipient.
9. These data have been developed based on BHDP's standard formatting, layering, drafting and design practice using technical processes and/or software main-

tained by BHDP, which may or may not be compatible with standards or software used by Recipient. These data may not always show information to scale.

10. The data is being provided as a "convenience" to the Recipient and is provided "as-is" without warranty. In the event of a conflict between BHDP's sealed contract drawings and these data, the sealed contract drawings shall govern. It is the Recipient's sole responsibility to determine whether a conflict exists.
11. **Due to the easily alterable nature of electronic/digital files, BHDP makes no warranties, either express or implied, with respect to the accuracy, completeness, merchantability, or fitness for any particular purpose, including, but not limited to, performance of electronic/digital files in cost estimating, quantity calculating, survey layout, or other software used by the Recipient, its Client or any other consultant or contractor.**
12. Use of any data will be at the Recipient's sole risk, and the Recipient releases and waives any and all claims against BHDP reasonably derivative of such data, and further agrees to indemnify, defend and hold BHDP, its parents, subsidiaries, affiliates, officers, partners, employees, agents, and lower-tier consultants harmless from all claims, damages, losses, and expenses including reasonable at-

torneys' fees and costs of defense actually or allegedly arising out of or resulting from any use of these data.

13. This constitutes the entire agreement and understanding of the parties and all other writings, expressions and/or representations, whether orally or in writing, shall be superseded by this Agreement.
14. This Agreement shall be governed by and construed in accordance with the laws of Ohio, without regard to conflict of laws principles. Any action brought under this Agreement shall be brought only in a court of competent jurisdiction located in Hamilton County, Ohio. The parties consent to the exclusive jurisdiction of such courts, and agree to accept service of process by mail.
15. Recipient, intending to be bound and obligated as described herein, has designated and authorized its representative, identified below, to execute this Agreement, as of _____, which shall be the effective date of this Agreement.

Recipient:

Firm Name: _____

By: _____

Printed Name: _____

Title: _____

SECTION 014000 - QUALITY REQUIREMENTS

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. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Construction Manager, 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 and Inspections: 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 Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
 - 1. Mockups are used for one or more of the following:

- a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. 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. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with 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.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. 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.
- J. 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 Architect or Construction Manager.
- 1.3 DELEGATED DESIGN SERVICES
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required,

submit a written request for additional information to Architect.

1.4 CONFLICTING REQUIREMENTS

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. **Contractor's Quality-Control Plan:** For quality-assurance and quality-control activities and responsibilities.
- B. **Qualification Data:** For Contractor's quality-control personnel.
- C. **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. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. **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.
- E. **Schedule of Tests and Inspections:** Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.

7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. 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.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract

requirements and approved mockups.

- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 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. Name, address, telephone number, and email address of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement of whether conditions, products, and installation will affect warranty.
 - 7. 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. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: 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.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: 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.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor's Responsibilities:
 - 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. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
 - e. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, 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.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups of size indicated.
 - 2. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
 - 3. Notify Architect and Construction Manager days in advance of dates and times when mockups will be constructed.
 - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 - 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 6. Obtain Architect's and Construction Manager's approval of mockups before starting corresponding Work, fabrication, or construction.

- a. Allow seven days for initial review and each re-review of each mockup.
7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.9 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. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: 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.
 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- D. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: 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. Contractor's Associated Requirements and Services: 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:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 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: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
 1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
 2. Distribution: Distribute schedule to Owner, Architect, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as follows:
 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.

- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Construction Manager's reference during normal working hours.

- 1. Submit log at Project closeout as part of Project Record Documents.

3.2 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 014000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 3. Section 017700 "Closeout Procedures" for submitting warranties.

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. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "Comparable Products" Article, 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. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluating Comparable Products: 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. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 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. Resolution of Compatibility Disputes between Multiple Contractors:
 - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products will be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is inconspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 2. Store products to allow for inspection and measurement of quantity or counting of units.
 3. Store materials in a manner that will not endanger Project structure.
 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 6. Comply with product manufacturer's written instructions for temperature, humidity,

- ventilation, and weather-protection requirements for storage.
- 7. Protect stored products from damage and liquids from freezing.
- 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.5 PRODUCT WARRANTIES

- A. Warranties specified in other Sections are to 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 standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to 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 in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

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," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect through Construction Manager in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. 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 not be considered.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. 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 that 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."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. 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 not 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."
6. 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 that 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."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. 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 may additionally 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 the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 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 Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action,

except to record noncompliance with the following 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.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. 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.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Submittal Requirements, Two-Step Process: Approval by Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering.
 - 3. Installation.
 - 4. Cutting and patching.
 - 5. Coordination of Owner's portion of the Work.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for coordination of Owner-furnished products, Owner-performed work, Owner's separate contracts, and limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
 - 5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

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

1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting

and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect and Construction Manager of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

- a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements

include but are not limited to the following:

- a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework,

investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

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

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect through Construction Manager in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. Engage a professional engineer experienced in laying out the Work, using the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar

reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and **90 inches** in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

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

until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

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

3.8 PROGRESS CLEANING

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

- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

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

"Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 MATERIALS OWNERSHIP

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

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 14 days of date established for commencement of the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Refrigerant Recovery: Comply with requirements in Section 024119 "Selective Demolition" for refrigerant recovery submittals.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.
- B. Refrigerant Recovery Technician Qualifications: Comply with requirements in Section 024119 "Selective Demolition."
- C. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:

- a. Asphalt paving.
- b. Concrete.
- c. Concrete reinforcing steel.
- d. Brick.
- e. Concrete masonry units.
- f. Wood studs.
- g. Wood joists.
- h. Plywood and oriented strand board.
- i. Wood paneling.
- j. Wood trim.
- k. Structural and miscellaneous steel.
- l. Rough hardware.
- m. Roofing.
- n. Insulation.
- o. Doors and frames.
- p. Door hardware.
- q. Windows.
- r. Glazing.
- s. Metal studs.
- t. Gypsum board.
- u. Acoustical tile and panels.
- v. Carpet.
- w. Carpet pad.
- x. Demountable partitions.
- y. Equipment.
- z. Cabinets.
- aa. Plumbing fixtures.
- bb. Piping.

- cc. Supports and hangers.
- dd. Valves.
- ee. Sprinklers.
- ff. Mechanical equipment.
- gg. Refrigerants.
- hh. Electrical conduit.
- ii. Copper wiring.
- jj. Lighting fixtures.
- kk. Lamps.
- ll. Ballasts.
- mm. Electrical devices.
- nn. Switchgear and panelboards.
- oo. Transformers.

2. Construction Waste:

- a. Masonry and CMU.
- b. Lumber.
- c. Wood sheet materials.
- d. Wood trim.
- e. Metals.
- f. Roofing.
- g. Insulation.
- h. Carpet and pad.
- i. Gypsum board.
- j. Piping.
- k. Electrical conduit.
- l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Wood pallets.
 - 8) Plastic pails.
- m. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
 - 1) Paper.
 - 2) Aluminum cans.
 - 3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
- B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for Sale, and, Donation: Not permitted on Project site.
- D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area off-site, designated by Owner.
 5. Protect items from damage during transport and storage.
- E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- G. Plumbing Fixtures: Separate by type and size.
- H. Lighting Fixtures: Separate lamps by type and protect from breakage.
- I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.
 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 1-1/2-inch size.
 - 2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.
- B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum 1-1/2-inch size.
 - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- D. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- E. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- F. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- G. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- H. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- I. Carpet Tile: Remove debris, trash, and adhesive.
 - 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- J. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- K. Conduit: Reduce conduit to straight lengths and store by material and size.
- L. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.

C. Burning: Do not burn waste materials.

D. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 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.
- 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.
 - 3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.02 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.

1.03 CLOSEOUT SUBMITTALS

- A Certificates of Release: From authorities having jurisdiction.
- B Certificate of Insurance: For continuing coverage.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- A A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.05 SUBSTANTIAL COMPLETION PROCEDURES

- A Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B Submittals Prior to Substantial Completion: Complete the following a minimum of 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 Architect. 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.
- C 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.
- D 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, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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 Architect, that must be completed or corrected before certificate will be issued.

1.06 FINAL COMPLETION PROCEDURES

- A Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012000 "Price and Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. 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.
 5. Submit final completion photographic documentation.
- B 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, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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.

1.07 LIST OF INCOMPLETE ITEMS

- 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 and proceeding from lowest floor to highest floor, listed by room or space number.
 - 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in the following format:
 - a. MS Excel Electronic File: Architect will return annotated file.

1.08 SUBMITTAL OF PROJECT WARRANTIES

- A Time of Submittal: Submit written warranties on request of Architect 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 Architect.
- 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

2.01 MATERIALS

- A Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 EXECUTION

3.01 FINAL CLEANING

- A 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 Project site of rubbish, waste material, litter, and other foreign substances.
 - b. 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.
 - c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - e. Vacuum and mop concrete.
 - 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 transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - h. Remove labels that are not permanent.

- i. Wipe surfaces of mechanical and electrical equipment[, elevator equipment,] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - l. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA ACR.
 - m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - n. Clean strainers.
 - o. Leave Project clean and ready for occupancy.
- C Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.02 REPAIR OF THE WORK

- A Complete repair and restoration operations required by Section 017300 "Execution" 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.
- 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before

commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

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

4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation in accordance with ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."
- 1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL
- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- 1.7 EMERGENCY MANUALS
- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.

2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.

4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

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

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

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

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

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare

- information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.
- 1.10 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the

following:

1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

- a. Initial Submittal:

- 1) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
- 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

- E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

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 Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. 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 prints 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.

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 annotated PDF electronic file.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

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

1.6 INSTRUCTION PROGRAM

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

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

- b. Repair instructions.
- c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

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

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Architect and Construction Manager with at least seven days' advance notice.
- D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

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

objective and lesson outline.

- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
- D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project Site.
 1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

- 1. Before selective demolition, Owner will remove the following items:

- a. Furniture.

- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

- D. Hazardous Materials:

- 1. It is not expected that hazardous materials will be encountered in the Work.

- a. Hazardous materials will be removed by Owner before start of the Work.
 - b. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

- 2. Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

- a. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - b. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
 - c. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

- E. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes

that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that

existing conditions are same as those indicated in Project Record Documents.

- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings.
 - 1. Inventory and record the condition of items to be removed and salvaged.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

- b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
- c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 024296 "Historic Removal and Dismantling."
- D. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items for reinstallation in project area.
 4. Protect items from damage during storage.
- E. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- F. Existing Items to Remain: Protect construction indicated to remain against damage and

soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.][and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

demolition operations began.

END OF SECTION 024119

SECTION 03 35 01
CONCRETE FINISHING (INTERIOR)

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Application of clear reactive, penetrating liquid hardener to interior concrete.
 - 2. Refining the interior concrete slab with a high grit diamond impregnated burnishing system.
 - 3. Application of stain resistant surface treatment.
- B. Related Requirements
 - 1. Section 01 25 00- Substitution Procedures.
 - 2. Section 01 33 00- Submittal Procedures.
 - 3. Section 01 60 00- Product Requirements.

1.02 REFERENCES

- A. The date of the standard is that in effect as the date of receipt of bids for the project.
- B. American Concrete Institute (ACI) – Specification for Polished Concrete Slab Finishes ACI 310.1-20.
- C. American National Standard Institute / National Floor Safety Institute:
 - 1. ANSI B101.1-Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Materials.
 - 2. ANSI B101.3-Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials.
- D. American Society of Concrete Contractors (ASCC).
- E. ASTM International (ASTM):
 - 1. C418 – Standard Test Method for Abrasion Resistance of Concrete by Sandblasting
 - 2. C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
 - 3. C1353 – Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform, Double-Head Abraser.
 - 4. D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
 - 5. D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 - 6. E96/96M Method B (Water Method) - Standard Test Methods for Water Vapor Transmission of Materials.
 - 7. G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.

1.03 NOT USED

1.04 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's product data sheets and tested physical and performance properties on products to be used for the work.
- B. VOC Certification: Submit certification that products furnished comply with regulations controlling use of volatile organic compounds (VOC).
- C. Certificates:
 - 1. Certificates by manufacturer stating that installer is listed applicator of special concrete finishes, and has completed the necessary training programs.
- D. Floor Protection Plan.
- E. Closeout Submittals: Submit the following:
 - 1. Laminated Maintenance Instructions: Operation and maintenance instructions for installed concrete flooring products in accordance with Division 1 Closeout Submittals Section. Include methods for maintaining final finish gloss and cleanliness of concrete slab surface.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Concrete Polishing Council (CPC) Craftsman Supervisor or equivalent on site during work.
 - 2. Applicator to be familiar with the specified requirements and the methods needed for proper performance of work of this section. Applicator must have availability of proper equipment to perform work within scope of this project on a timely basis. Applicator should have successfully performed a minimum of 5 projects of similar scope and complexity.
- B. Inspection and testing: Cooperate and coordinate with the Owner's inspection and testing agency.
 - 1. Personnel performing field tests shall conform to ACI 310.1.
 - 2. Dynamic Coefficient of Friction Testing:
 - a. Preparation: Begin DCOF testing only after cleaning the floor surface with a non-etching cleaner to remove topical coatings and contaminants. Allow test surfaces to dry completely.
 - b. Test Method: Test DCOF on wet slab surface with 0.05% surfactant in accordance with the requirements of ANSI A 326.3 using BOT3000E equipment.
 - c. Installer shall make reasonable accommodations to complete the testing with the Architect, The Owner, and the Owners Representative present.
- C. Mock-up: On site, prior to the first application of the densifier.
 - 1. Require attendance of parties directly affecting work of this Section, including the Contractor, Architect, applicator, and Owner's Representative.
 - 2. Notify the above parties one week in advance of date and time when mock-up will be completed.
 - 3. Demonstrate the materials, equipment and application methods to be used for work specified herein in pre-approved location approximately 50 sq. ft. in area or as directed by Owner's Representative.
 - 4. Retain approved mock-up during construction as a standard for judging the completed Work. Areas may remain as part of the completed work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original containers, with seals unbroken, bearing manufacturer labels indicating brand name and directions for storage.
- B. Store concrete hardener/densifier in environment recommended on published manufacturer's product data sheets.
 - 1. Store containers upright in a cool, dry, well-ventilated place, out of the sun, with temperature between 40 and 100 degrees Fahrenheit (4 and 38 degrees Celsius).
 - 2. Protect from freezing.
 - 3. Store away from other chemicals and potential sources of contamination.
 - 4. Keep lights, fire, sparks and heat away from containers.
 - 5. Do not drop containers or slide across sharp objects.
 - 6. Do not stack pallets more than three high.
 - 7. Keep containers tightly closed when not in use.

1.07 FIELD CONDITIONS

- A. Environmental limitations:
 - 1. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting performance and finishing requirements.
- B. Close areas to traffic during floor application and after application for time period recommended in writing by manufacturer.
- C. Protect the completed slab to prevent damage by the other trades during floor completion.
- D. Temperature Limitations:
 - 1. Apply when surface and air temperature are between 40 degrees Fahrenheit (4 degrees Celsius) and 95 degrees Fahrenheit (35 degrees Celsius) unless otherwise indicated by manufacturer's written instructions.
 - 2. Apply when surface and air temperatures are expected to remain above 40 degrees Fahrenheit (4 degrees Celsius) for a minimum of 8 hours after application unless otherwise indicated by manufacturer's written instructions.
- E. Apply when air conditions are calm to minimize surface treatment contacting surface not intended to be finished.
- F. Do not apply to frozen substrate. Allow adequate time for substrate to thaw, if freezing conditions exist before application.
- G. Temporary Lighting: Minimum 200 W light source, placed 8 feet (2.5 meters) above horizontal concrete surface for each 425 square feet (40 square meters) of concrete being finished.
- H. Temporary Heat: Ambient temperature of 50 degrees Fahrenheit (10 degrees Celsius) minimum.
- I. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Substitutions: In accordance with Section 01 25 00 – Substitution Procedures.

2.02 MATERIALS

- A. Pre-Densifier Concrete Cleaner: Cleaner to remove dirt, oil, grease, and other stains from existing slab surface.
 - 1. Product: [Consolideck Cleaner/Degreaser](#) manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- B. Penetrating Concrete Hardener/Densifier: Blended silicate hardener/densifier.
 - 1. Product: [Consolideck Blended Densifier](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
 - 2. Subject to compliance with the following minimum performance requirements:
 - a. Comply with national, state and district AIM VOC regulations and contain 50 g/L or less.
 - b. Microabrasion Resistance: Greater than 30 percent improvement over the untreated samples when tested in accordance with ASTM C418.
 - c. Abrasion Resistance: Greater than 40 percent improvement over untreated samples when tested in accordance with ASTM C1353.
 - d. Achieve 'High Traction Range' readings when tested in accordance with ANSI B101.1 and ANSI B101.3.
 - e. Coefficient of Friction: Greater than 0.60 dry, Greater than 0.60 wet when tested in accordance with ASTM C1028.
 - f. Adhesion: Greater than 10 percent increase in pull-off strength when compared to an untreated sample when tested in accordance with ASTM D4541.
 - g. Water Vapor Transmission: 99 percent retained when compared to untreated samples when tested in accordance with ASTM E96/96M Method B (Water Method).

Interior Concrete Protective Treatments:

- 1. General Purpose medium gloss, film forming sealer.
 - a. Product: [Consolideck PolishGuard](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
 - b. Subject to compliance with the following requirements:
 - i. Comply with national, state and district AIM VOC regulations.
 - ii. Achieve 'High Traction Range' readings when tested in accordance with ANSI B101.1 and ANSI B101.3.
 - iii. Coefficient of Friction: Greater than 0.60 dry, Greater than 0.60 wet when tested in accordance with ASTM C1028.
 - iv. Stain Resistance: Achieve limited or no adverse effects when tested in accordance with ASTM D1308.
 - v. UV Stability: No degradation or yellowing of material when tested in accordance with ASTM G154.
- 2. Solvent-based, penetrating clear sealer with a VOC content of 100 g/L or less shall resist oil and food stains, and repel water and water-related stains.
 - a. Product: [Consolideck Concrete Protector SB](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
 - b. Subject to compliance with the following requirements:
 - i. Comply with national, state and district AIM VOC regulations.
 - ii. Achieve 'High Traction Range' readings when tested in accordance with ANSI B101.1 and ANSI B101.3.
 - iii. Stain Resistance: Achieve limited or no adverse effects when tested in accordance with ASTM D 1308.

- iv. UV Stability: No degradation or yellowing of material when tested in accordance with ASTM G154.

2.03 EQUIPMENT

- A. Conform to ACI 310.1 Part 2.2, except where more stringent requirements are specified below.
- B. Auto Scrubber Machine: For cleaning operations.
- C. Burnishing Machine and Diamond Impregnated Burnishing Pads to produce specified results.
 - 1. Burnishing Machine: High speed burnisher, generating pad speeds of 1,500 RPM or higher, as recommended by diamond impregnated burnishing system manufacturer. Dust skirt must be installed at time of work.
 - 2. Diamond Impregnated Burnishing Pads:
 - a. Resin Diamond Pad Grit Sizes: 800, 1500 or 3000 grit.

2.04 CONCRETE MAINTENANCE SUPPLIES

- A. Concrete Maintenance Cleaner: Lithium silicate concentrated maintenance cleaner to keep maintain concrete surface sheen and remove dirt and soils.
 - 1. [Consolideck LSKlean ULTRA](#) [15] [30], pre-measured 4 oz packs, manufactured by PROSOCO, Inc., www.prosoco.com, (NO SUBSTITUTE).
- B. Floor Maintenance Pads:
 - 1. White floor maintenance pads.
- C. Spill Clean-up Kit: Provide critical cleaning items to remove spills from concrete floors. Spill Clean-up Kit should include the following:
 - 1. One quart of Consolideck Cleaner Degreaser, one quart of Consolideck Oil and Grease Remover, two pound Spill Guard Neutralizer Absorbent, one package of multi absorbent shop towels, one small plastic scraper, one hand broom and dust pan, a collapsible warning sign, 50 waste bags liners for 24 x 24 can liner, and one box of general purpose vinyl gloves.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate with installer present for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Notify the Owner's Representative in writing of conditions detrimental to the proper and timely completion of the work.
- B. Do not begin installation until unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

3.02 PREPARATION

- A. Clean dirt, dust, oil, grease and other contaminants that interfere with penetration or performance of specified product from surfaces.

- B. Remove remnants of curing compound, bond breaker, and construction laitance prior to application of densifier. Remove by cleaning and scrubbing in accordance with manufacturer's instructions.
- C. Repair, patch and fill cracks, voids, defects and damaged areas in surface as approved by the Owner's Representative. Allow repair materials to cure completely before application of product.
- D. Scrub floor with pre-densifier floor cleaner to remove latent salts.
- E. Do not proceed until unsatisfactory conditions have been corrected.

3.03 INTERIOR CONCRETE SLAB SURFACE REFINEMENT SYSTEM

- A. Adhere to industry standard and conform to ACI 310.1, except where more stringent requirements are specified below.
- B. Sequential progression of surface refinement shall be required and limited to no more than double the grit value of the previous diamond grit used after application of the concrete hardener/densifier.
- C. Overlap adjacent burnishing passes by 25 percent
- D. Perform each pass perpendicular to the other pass north/south then east/west; multiple passes may be needed.
- E. Progressively refine surface utilizing approved diamond impregnated burnishing system, to produce Finishing Requirements.

3.04 APPLICATION OF INTERIOR CONCRETE PROTECTIVE TREATMENT

- A. Application of general purpose, medium gloss protective treatment:
 - 1. Apply per manufacturer's published recommendations to clean, dry slab at the completion of refining the slab surface with the high grit diamond impregnated burnishing system. Lightly wet a clean microfiber pad with protective treatment and wring out excess, leaving the pad damp.
 - 2. Spray-apply protective treatment using a clean, pump-up sprayer fitted with a 0.5 gpm conical or fan spray tip at an estimated coverage rate of 400 to 800 square feet per gallon. Work from one control joint to another.
 - 3. Spread with the damp microfiber pad. Maintain a thin, even coating and wet edge. Stop spreading once drying begins. Do not overlap. Repeat steps 1 through 4. Two coats are recommended for maximum protection.
 - 4. To increase gloss, wait at least 60 minutes after the final coat is applied, then use a high-speed burnisher fitted with a white polishing pad. Burnish at a fast walking pace.
- B. Application of solvent-based, penetrating oil, water and food stain protective treatment with a VOC content of 100 g/L or less:
 - 1. Apply per manufacturer's published recommendations to clean, dry slab at the completion of refining the slab surface with the high grit diamond impregnated burnishing system.
 - 2. Lightly wet a clean microfiber pad with protective treatment, leaving the pad damp.
 - 3. Using a clean, pump-up sprayer, and working from one control joint to another, apply a light, fine spray to a small section of the floor. Apply per manufacturer's published recommended application rate.

4. Using the damp microfiber pad and firm downward pressure, immediately spread protective treatment to produce a thin, even application. Spread the product as far as possible while maintaining a wet edge.
5. Allow to dry tack free, typically 60–90 minutes.
6. Two coats are recommended for maximum protection. Repeat steps 1 through 4.
7. To remove any subsequent haze or for a high-gloss finish, wait until the final coat is dry, a minimum of 4 hours, then use a high-speed burnisher fitted with a PROSOCO heat polishing pad or 1500–3000 grit diamond polishing pad.

3.05 FINISHING REQUIREMENTS

A. Appearance:

1. Interior exposed finished slab areas must consist of the following:
 - a. Slab surface must meet the desired sheen, as discussed in Pre-Installation meeting and be consistent with approved Mock-up.
 - b. Slab surface must have a consistent look and exhibit a finish that has no evidence of streaking or burnish marks.
 - c. White residue or hazy appearance is not acceptable.
1. Interior exposed finished slab areas must consist of the following CPAA Gloss Level:
 - a. Interior exposed finished slab areas must meet the ACI 310.1 Table 3.2.4.1- Appearance levels for distinctness of image (DOI) Level 2.

3.06 SLAB PROTECTION

- A. Comply with provisions of ACI 310.1 specification for slab protection, except where more stringent requirements are specified below Protect finished floors to prevent damage including staining, gouges and scratching by construction traffic and activities until possession.
- B. Do not drag or drop equipment or material across the slab which will scratch or chip it.
- C. Inspect tires for debris prior to use on slab. Remove embedded items which may cause damage to floor slab.
- D. Clean up spills on slab immediately. Provide cleaning chemicals and absorptive materials.
- E. Develop a concrete protection procedure which addresses the following procedures:
 1. Communication of protection plan to subcontractors and vendors.
 2. Procedures for cleaning up slab spills, including use of and availability of cleaning chemicals and absorptive materials at Site.
- F. Provide a clean slab surface using concrete maintenance cleaner within an auto scrubber, equipped with soft nylon brushes, in accordance with manufacturer's published recommendations.

3.07 CLOSEOUT ACTIVITIES

- A. Provide and post the laminated methods for maintaining final finish gloss and cleanliness of concrete slab surface in a room within the finished space.
- B. Post 16" x 30" Concrete Floor Maintenance Guidelines provided by concrete flooring chemical manufacturer.
 1. Contact PROSOCO, Inc. at 800.255.4255 to obtain colored poster.

- C. Provide Store Manager the following concrete floor maintenance supplies:
1. One Spill Clean-Up Kit.
 2. cases, pre-measured 4 oz Concrete Maintenance Cleaner Packs.
 3. 2 Floor Maintenance Pads.

END OF SECTION 033501

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood products.
 - 2. Fire-retardant-treated lumber.
 - 3. Miscellaneous lumber.
- B. Related Requirements:
 - 1. Section 064023 "Interior Architectural Woodwork" for interior wood stairs and railings.

1.2 REFERENCE STANDARDS

- A. AWP A U1 - Use Category System: User Specification for Treated Wood 2023.
- B. SPIB (GR) - Standard Grading Rules 2021.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates:
 - 1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
 - 2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Dress lumber, S4S, unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
 - 2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Application: Treat all rough carpentry unless otherwise indicated.

2.3 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Framing
 - 3. Nailers.
 - 4. Furring.
- B. Dimension Lumber Items: Construction or No. 2, Standard, Stud, or No. 3 grade lumber of the following species:
 - 1. Mixed southern pine or southern pine; SPIB.
- C. Utility Shelving: Lumber with 19 percent maximum moisture content of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.

2.4 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329, of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.5 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Do not splice structural members between supports unless otherwise indicated.
- C. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- D. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 2. ICC-ES evaluation report for fastener.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

END OF SECTION

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior standing and running trim for opaque finish.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.

1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Anchors.
 - 2. Adhesives.
 - 3. Shop finishing materials.
- B. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- C. Shop Drawings:
 - 1. Include the following:
 - a. Dimensioned plans, elevations, and sections.
 - b. Attachment details.
 - 2. Show large-scale details.
 - 3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
 - 4. Apply AWI Quality Certification Program label to Shop Drawings.
- D. Samples: For each exposed product and for each shop-applied color and finish specified.
 - 1. Size:
 - a. Panel Products: 12 inches by 12 inches.
 - b. Lumber Products: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
- E. Samples for Initial Selection: For each type of shop-applied exposed finish.
 - 1. Size:

- a. Panel Products: 12 inches by 12 inches.
 - b. Lumber Products: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
- F. Samples for Verification: For the following:
 - 1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
 - 2. Lumber and Panel Products with Shop-Applied Opaque Finish: 5 inches wide by 12 inches long for lumber and for panels, for each finish system and color.
 - a. Finish entire exposed surface.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For architectural woodwork manufacturer and installer.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Architectural Woodwork Standards, Section 2.
- B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
- C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
 - 1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.8 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.
- B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate

measurements on Shop Drawings.

- C. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 - 1. The Contract Documents contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

2.2 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Architectural Woodwork Standards Grade: Custom.
 - 1. Wood Species: As indicated on drawings.

2.3 HARDWOOD SHEET MATERIALS

- A. Composite Wood Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 - 2. Particleboard: ANSI A208.1, Grade M-2.

2.4 MISCELLANEOUS MATERIALS

- A. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
 - 1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
 - 2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.5 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
 - 1. Ease edges to radius indicated for the following:

- a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
 - b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch.
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
 - 1. Disassemble components only as necessary for shipment and installation.
 - 2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

2.6 SHOP FINISHING

- A. Finish interior architectural woodwork indicated on Drawings at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.
- C. Opaque Finish:
 - 1. Architectural Woodworking Standards Grade: Custom.
 - 2. Finish System:
 - 3. Color: Match Architect's sample.
 - 4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter in accordance with ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.
- B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

- A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
- B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
- C. Install interior architectural woodwork level, plumb, true in line, and without distortion.
 - 1. Shim as required with concealed shims.

2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes in accordance with AWPA M4.
- F. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- G. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
 1. Secure with countersunk, concealed fasteners and blind nailing.
 2. Use fine finishing nails for exposed fastening, countersunk and filled flush with interior architectural woodwork.
 3. For shop-finished items, use filler matching finish of items being installed.
- H. Standing and Running Trim:
 1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
 2. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary.
 3. Scarf running joints and stagger in adjacent and related members.
 4. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished.
 5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 1. Inspection entity is to prepare and submit report of inspection.

3.4 REPAIR

- A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects.
- B. Where not possible to repair, replace defective woodwork.
- C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.
 1. Fill nail holes with matching filler where exposed.
 2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.5 CLEANING

- A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plastic-laminate-clad architectural cabinets.
 - 2. Cabinet hardware and accessories.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.

1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Plastic-laminate-clad architectural cabinets.
 - 2. Cabinet hardware and accessories.
 - 3. Miscellaneous materials.
- B. Product Data Submittals: For each product.
 - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- C. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
 - 4. Apply AWI Quality Certification Program label to Shop Drawings.
- D. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.
- E. Samples for Verification: For the following:
 - 1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.
 - a. Provide one sample applied to core material with specified edge material applied to one edge.
 - 2. Thermally Fused Laminate (TFL) Panels: 8 by 10 inches, for each color, pattern, and

surface finish.

- a. Provide edge banding on one edge.
- 3. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer, and, Installer.
- B. Product Certificates: For the following:
 - 1. Composite wood products.
 - 2. Thermally fused laminate panels.
 - 3. High-pressure decorative laminate.
 - 4. Adhesives.

1.5 CLOSEOUT SUBMITTALS

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. Exposed Surfaces:
 - 1. Plastic-Laminate Grade: HGS,VGS.
 - 2. Edges: Grade HGS,Grade VGS.
 - 3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- F. Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, ISO 4586-3.
 - a. Edges of Plastic-Laminate Shelves: .
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, ISO 4586-3, grade to match exposed surface.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber.
 - 3. Drawer Bottoms: Hardwood plywood.
- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3, grade to match exposed surface.
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
- I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. All laminate finishes as indicated on drawings.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 - 2. Particleboard (Medium Density): ANSI A208.1, Grade M-2.

3. Softwood Plywood: DOC PS 1, medium-density overlay.
4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of ISO 4586.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.
 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 170 degrees of opening, self-closing.
- B. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.
- C. Bar Pulls: As indicated on drawings.
- D. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
- E. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
- F. Drawer Slides: ANSI/BHMA A156.9.
 1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
 - a. Type: Full overtravel extension.
 - b. Material: Epoxy-coated polymer slides.
 - c. Motion Feature: Push to open and soft close dampener.
- G. Door Locks: ANSI/BHMA A156.11, E07121.
- H. Drawer Locks: ANSI/BHMA A156.11, E07041.
- I. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- J. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 1. Color: As indicated on drawings.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated. Finish as indicated on drawings.
 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Architect's sample.

2. Bright Brass, Clear Coated: ANSI/BHMA 605 for brass base; ANSI/BHMA 632 for steel base.
 3. Bright Brass, Vacuum Coated: ANSI/BHMA 723 for brass base; ANSI/BHMA 729 for zinc-coated-steel base.
 4. Satin Brass, Blackened, Bright Relieved, Clear Coated: ANSI/BHMA 610 for brass base; ANSI/BHMA 636 for steel base.
 5. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
 6. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
 7. Satin Stainless Steel: ANSI/BHMA 630.
- L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.
1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
 2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 - 1. Inspection entity is to prepare and submit report of inspection.

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Penetration firestopping systems.
 - 1. Penetration firestopping systems in fire-resistance-rated walls.
 - 2. Penetration firestopping systems in horizontal assemblies.
 - 3. Penetration firestopping systems in smoke barriers.
- B. Related Requirements:
 - 1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.
 - 2. Section 079200 "Joint Sealants" for non-fire-resistance-rated joint sealants.
 - 3. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.2 PREINSTALLATION MEETINGS

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
- C. Unlisted Firestopping Systems: Obtain an Engineering Judgment (EJ) from firestopping manufacturer where no UL, FM Approvals, or other listed assembly is available for particular firestop configuration. Follow International Firestop Council (IFC) recommended guidelines for evaluating firestopping systems in EJs.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) recommended guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

- A. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping systems when ambient

or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

- B. Install and cure penetration firestopping system materials in accordance with manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be accessed and installed in accordance with specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PENETRATION FIRESTOPPING SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M Building and Construction
 - 2. Hilti, Inc.
 - 3. Tremco Incorporated
- B. Penetration firestopping systems must be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 1. Penetration firestopping systems must be installed with products bearing the classification marking of a qualified testing agency.
 - a. UL Solutions in its online directory "Product iQ."
 - 2. Provide components for each penetration firestopping system that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during and after construction.
 - 3. Provide components for each penetration firestopping system that do not contain ethylene glycol.
 - 4. Provide components for each penetration firestopping system that are sufficiently flexible to accommodate movement, such as pipe vibration, water hammer, thermal expansion, and other normal building movement without damage.
 - 5. Provide components for each penetration firestopping system that are appropriately tested for the thickness and type of insulation utilized.
- C. Provide penetration firestopping systems that resist spread of fire, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- D. Penetration Firestopping Systems in Fire-Resistance-Rated Walls: Systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: Not less than the fire-resistance rating of the wall assembly penetrated.
- E. Penetration Firestopping Systems in Horizontal Assemblies: Systems with ratings determined in accordance with ASTM E814 or UL 1479.
 1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor/ceiling assembly penetrated.
- F. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84 or UL 723.

2.2 ACCESSORIES

- A. Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated, including but not limited to:
 1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestopping Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestopping Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, and when required by a listed system, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed or dislodged.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings in accordance with manufacturer's written instructions and with the following requirements:
 - 1. Remove foreign materials from substrate surfaces that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates in accordance with penetration firestopping system manufacturer's written installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

- A. General: Install penetration firestopping systems in accordance with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. from end of wall and at intervals not exceeding 30 ft..
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A Nonsag gunnable joint sealants.
- B Self-leveling pourable joint sealants.
- C Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A Sustainability Requirements apply to this Section and include:
 - 1. Section 016000 – Product Requirements
 - 2. Section 017419 - Construction Waste Management and Disposal

1.03 REFERENCE STANDARDS

- A ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- B ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.

1.04 SUBMITTALS

- A Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
- B Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- C Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

- D Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- E Installation Plan: Submit at least four weeks prior to start of installation.

1.05 QUALITY ASSURANCE

- A Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
 - 4. Allow sufficient time for testing to avoid delaying the work.
 - 5. Deliver to manufacturer sufficient samples for testing.
 - 6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 - 7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
- B Installation Plan: Include schedule of sealed joints, including the following.
 - 1. Joint width indicated in Contract Documents.
 - 2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
 - 3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgement that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
 - 4. Approximate date of installation, for evaluation of thermal movement influence.
- C Mockup: Prepare a mockup panel with an 8 inch long mockup of each type and color of sealant for finish and color verification.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A Products: Subject to compliance with requirements, provide products listed in other Part 2 articles by one of the following manufacturers. Shortened versions (shown in parentheses) of the manufacturers' names are used in Part 2:
 - 1. (BOS) Bostik, Inc.
 - 2. (DOW) Dow Chemical Company.
 - 3. (GE) GE Construction Sealants; Momenive Performance Materials, Inc.

4. (HIL) Hilti, Inc.
5. (MBS) Master Builders Solutions
6. (MAY) May National Associates, Inc.; A Subsidiary of Sika Corporation U.S.
7. (OSI) OSI Sealants; Henkel Corporation.
8. (PEC) Pecora Corporation.
9. (SIK) Sika Corporation; Joint Sealants.
10. (STI) Specified Technologies, Inc.
11. (SWC) Sherwin-Williams Co. (The).
12. (TRM) Tremco Commercial Sealants & Waterproofing.
13. (USG) USG Corporation.

2.02 JOINT SEALANT APPLICATIONS AND TYPES

- A Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed.
1. Vertical surfaces and horizontal nontraffic surfaces: **S-1.**
 2. Horizontal traffic surfaces: **S-8.**
- B Interior Joints
1. Vertical surfaces and horizontal nontraffic surfaces: **S-1.**
 2. Mildew-resistant on vertical surfaces and horizontal nontraffic surfaces: **S-3.**
 - a. Joint Locations: Joints between plumbing fixtures and adjoining walls, floors, and counters, tile control and expansion joints where indicated, other joints as indicated on Drawings.
 3. Horizontal traffic surfaces: **S-8.**
 4. Vertical and horizontal nontraffic, nonmoving joints. **S-10.**
 5. Acoustical joints in vertical surfaces and horizontal nontraffic surfaces: **S-11**
- C Butyl Rubber Sealant
1. Where indicated on Drawings or specified for use in other Sections: **S-12**
- D General Scope:
1. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.

2.03 JOINT SEALANTS - GENERAL

- A Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 016116.

2.04 SILICONE JOINT SEALANTS

- A **S-1:** Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. DOW DOWSIL 791.
 2. GE SilPruf SCS2000.
 3. PEC 864 NST.
 4. SIK Sikasil WS 295.
 5. TRM Spectrem 3.
- B **S-3:** Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid or neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. DOW DOWSIL 786-M.
 2. GE Sanitary SCS1700.
 3. PEC 898NST.
 4. MAY Bondaflex Sil 100WF.
 5. TRM Tremsil 200.

2.05 URETHANE JOINT SEALANTS

- A **S-8:** Urethane, S or M, NS or P, 25, T, NT: Single-component, nonsag or pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
1. MBS MasterSeal NP1 or MasterSeal SL 1.
 2. PEC Urexpan NR-201.
 3. SIK Sikaflex - 1a or Sikaflex - 1CSL or Sikaflex - 2c NS
 4. TRM Vulkem 116 or Vulkem 45SSL.

2.06 LATEX JOINT SEALANTS

- A **S-10:** Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
1. GE Ultra Seal.
 2. MBS MasterSeal NP 520

3. PEC AC-20.
4. SWC 850A.
5. TRM Tremflex 834.

2.07 ACOUSTICAL JOINT SEALANTS

A **S-11:** Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. HIL CP 506 Smoke and Acoustical Sealant.
2. OSI Henkel Corp.; OSI SC-170.
3. PEC AIS-919 or AC-20 FTR.
4. STI SpecSeal Smoke 'N' Sound Sealant.
5. TRM Tremco Acoustical Sealant.
6. USG SHEETROCK Acoustical Sealant.

2.08 BUTYL JOINT SEALANTS

A **S-12:** Butyl-Rubber-Based Joint Sealants: ASTM C1311.

1. BOS Chem-Calk 300
2. PEC BC-158.
3. TRM Tremco Butyl Sealant.

2.09 ACCESSORIES

A **Backer Rod:** Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

1. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B **Backing Tape:** Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C **Masking Tape:** Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D **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.

- E Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify that joints are ready to receive work.
- B Verify that backing materials are compatible with sealants.
- C Verify that backer rods are of the correct size.

3.02 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 all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. 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 of joint sealants.
- B Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

- C Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION

- A Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B Perform installation in accordance with ASTM C1193.
- C Perform acoustical sealant application work in accordance with ASTM C919.
- D Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
 - 1. Width/depth ratio of 2:1.
 - 2. Neck dimension no greater than 1/3 of the joint width.
 - 3. Surface bond area on each side not less than 75 percent of joint width.
- F Install bond breaker backing tape where backer rod cannot be used.
- G Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- H Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- I Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- J Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

- B STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.05 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 ft. Insert dimension of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants in accordance with Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
- 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.
- C Prepare test and inspection reports.

END OF SECTION

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Acoustical joint sealants.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.
- C. Samples for Verification: For each type and color of acoustical joint sealant required.
 - 1. Size: 1/2-inch- wide sealant joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Acoustical 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. Test and Evaluation Reports:
 - 1. Product Test Reports: For each type of acoustical joint sealant, for tests performed by qualified testing agency.
- B. Sample warranties.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained between 40 and 95 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.5 WARRANTY

- A. Installer's Special Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Manufacturer's Special Warranty: Manufacturer agrees to furnish acoustical joint sealants

to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACOUSTICAL JOINT SEALANTS

- A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.
- B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation
 - b. GE Construction Sealants: Momentive Performance Materials Inc; RCS20 Acoustical
 - c. Tremco Incorporated; Tremco Acoustical Sealant
 - d. United States Gypsum Company: SHEETROCK Acoustical Sealants
 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint

sealants to comply with joint-sealant manufacturer's written instructions.

- B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

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. Standard and custom hollow metal doors and frames.
 - 2. Steel sidelight, borrowed lite and transom frames.
 - 3. Louvers installed in hollow metal doors.
 - 4. Light frames and glazing installed in hollow metal doors.

- B. Related Sections:

- 1. Division 01 Section "General Conditions".
 - 2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
 - 3. Division 08 Section "Flush Wood Doors".
 - 4. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
 - 5. Division 08 Section "Door Hardware".
 - 6. Division 08 Section "Access Control Hardware".
 - 7. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

- 1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
 - 2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
 - 3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - 4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
 - 5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.

6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. 10. SDI-113 Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door & Frame Assemblies.
10. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
11. ASTM C1199 - Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
12. ASTM E1423 - Practice for Determining Steady State Thermal Transmittance of Fenestration Systems.
13. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
14. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
15. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
16. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
17. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
18. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
19. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
 1. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
 - 1. CECO Door Products (C).
 - 2. Curries Company (CU).

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Design: Flush panel.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - 2. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
 - 3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 - 4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 - 5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 - 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 2. Frames: Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel sheet.
 - 3. Manufacturers Basis of Design:
 - a. CECO Door Products (C) - DU Series.
 - b. CECO Door Products (C) - SQ SU SR Series.
- C. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 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 thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 - 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
 - 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 - 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
- D. Hollow Metal Frames:
 - 1. Shipping Limitations: 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.
 - 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
 - 3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
 - 5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
 - 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.

7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
 8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on-center and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. 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 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
 10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
 11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

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. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.
- E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 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 and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Fire-rated wood door frames.

B. Related Requirements:

1. Section 087100 "Door Hardware".
2. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).

1.3 ACTION SUBMITTALS

A. Product Data:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Fire-rated wood door frames.

B. Product Data Submittals: For each product, including the following:

1. Door core materials and construction.
2. Veneer species.
3. Door face type and characteristics.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Dimensions and locations of blocking for hardware attachment.
4. Dimensions and locations of mortises and holes for hardware.
5. Clearances and undercuts.
6. Requirements for veneer matching.
7. Doors to be factory finished and application requirements.
8. Provide information as required by AWI/AWMAC/WI (AWS).

D. Samples for Verification:

1. Submit two samples of door veneer, illustrating wood grain, stain color, and sheen.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver, and store doors in accordance with the specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging, sealed with heat shrunk plastic. Do not store in damp or wet areas or areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week, and break seal on-site to permit ventilation.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) beyond specified installation tolerances.
 - c. Telegraphing of core construction.
 - 2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C, or, NFPA 252.

2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

- A. Quality Standards: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches (44 mm) thick, unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Wood veneer facing with factory transparent finish.
- C. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

2.3 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 min Rated Doors: Type structural composite lumber core (SCLC), plies, and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage

of hardware without through-bolting.

2.4 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White Birch, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 - 1. Vertical Edges: Same species as face veneer.
 - 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet (3m) of each other when doors are closed.
 - 3. "Running Match" each pair of doors and doors in close proximity to each other.
 - 4. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements quality standard indicated.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
 - 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Fabricate doors in accordance with door quality standard specified.
- C. Cores constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
 - 2. Provide solid blocking for other through-bolted hardware.
- D. Factory machine doors for hardware that is not surface applied.
 - 1. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 - 2. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
 - a. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable.
- E. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
 - 3. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
- F. Exterior Doors: Factory treat exterior doors with water repellent after fabrication has been completed but before factory finishing.
 - 1. Flash top of outswinging doors with manufacturer's standard metal flashing.

2.6 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 - 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 2. Finish faces, all four edges, edges of cutouts, and mortises.
 - 3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors in accordance with approved sample.
- C. Transparent Finish:
 - 1. Architectural Woodwork Standards Grade: Custom.
 - a. System-5, Varnish, Conversion.
 - 2. Staining: As selected by Architect from manufacturer's full range.
 - 3. Sheen:
 - a. Flat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
 - 1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
 - 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
 - 3. Install fire-rated doors and frames in accordance with NFPA 80.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
 - 1. Do not field cut or trim: if fit or clearance is not correct, replace door.

- E. Field modifications to doors shall not be permitted, except those specifically allowed by manufacturer or fire rating requirements.

3.3 FIELD QUALITY CONTROL

- A. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- B. Tolerances:
 - 1. Comply with specified quality standard for fit and clearance tolerances.
 - 2. Comply with specified quality standard for telegraphing, warp, and squareness.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flush access doors with exposed flanges.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Schedule: For access doors and frames.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For testing and inspecting agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, in accordance with NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges:
 - 1. Basis of Design: Acudor – GFRG-R Glass Fiber Reinforced Gypsum Radius corner
 - 2. Description: Face of door flush with frame, concealed flanges
 - 3. Locations: Drywall ceilings
 - 4. Door Size: 12 in x 12 in.
 - 5. Uncoated Steel Sheet for Door: Nominal 1.25" inch thickness
 - 6. Frame Material: Same material, thickness, and finish as door.
 - 7. Latch and Lock: none
- B. Flush Access Doors with Exposed Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis
 - b. JL Industries; Activar Construction Products Group, Inc.
 - c. Larsen's Manufacturing Company
 - d. MIFAB, Inc
 - e. Milcor by Duravent; Duravent Group.

f. Acudor

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Optional Features: Piano hinges.
4. Locations: Wall.
5. Door Size: 12 in x 12 in.
6. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
7. Frame Material: Same material, thickness, and finish as door.
8. Latch and Lock: Cam latch, spanner-head wrench operated, Prepared for mortise cylinder.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Latch and Lock Hardware:
 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 2. Keys: Furnish two keys per lock and key all locks alike.
 3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."
- E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.5 FINISHES

- A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are 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.

- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION OF ACCESS DOORS AND FRAMES

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum-framed storefront systems.
 - 2. Aluminum-framed entrance door systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
 - 2. Include point-to-point wiring diagrams.
- C. Samples: For each type of exposed finish required.
- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.
- E. Delegated Design Submittals: For aluminum-framed entrance and storefront systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.
- B. Product test reports.
- C. Sample warranties.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is

certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

1.5 WARRANTY

- A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked-enamel, powder-coat, or organic finishes within specified warranty period.

1. Warranty Period: Manufacturer's standard warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, license in the state in which the Project is located to design aluminum-framed entrance and storefront systems.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
1. Wind Loads: As indicated on Drawings, but not less than 30 psf acting inward and outward per ASTM E330.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.
 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

- a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
3. Cantilever Deflection: Limited to $2L/175$ at unsupported cantilevers.
- E. Structural: Test in accordance with ASTM E330/E330M as follows:
 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
 1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
 1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.45 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 - b. Entrance Doors: U-factor of not more than 0.80 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 2. Solar Heat-Gain Coefficient (SHGC):
 - a. Fixed Glazing and Framing Areas and Entrance Doors: SHGC for the system of not more than 0.40 as determined in accordance with NFRC 200.
 3. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.
 - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
 4. Condensation Resistance Factor (CRF):
 - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.
 - b. Entrance Doors: CRF of not less than 63 as determined in accordance with AAMA 1503.
 - c. Exterior Doors and Framing at Indoor Pool Areas: Maximum available CRF as determined in accordance with AAMA 1503.

- H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

- 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STOREFRONT SYSTEMS

- A. Source Limitations: Storefront framing and entrance doors shall be provided by a single source manufacturer with a single warranty.

- 1. Basis of Design: Subject to compliance with requirements, provide Kawneer Company, Inc., Arconic Corporation; Trifab Versaglaze 451T, or a comparable product from one of the following:

- a. EFCO Corporation; System 403T.
 - b. Oldcastle BuildingEnvelope (OBE); Series 3000 Thermal MultiPlane.
 - c. YKK AP America Inc.; YES-45-TU.

- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

- 1. Exterior Framing Construction: Thermally broken.
 - 2. Interior Framing Construction: Nonthermal.
 - 3. Sub-sill: Manufacturer's standard extruded aluminum, thermally broken sub-sill.
 - 4. Glazing System: Retained mechanically with gaskets on four sides.
 - 5. Finish: High-performance organic finish.
 - 6. Fabrication Method: Field-fabricated stick system.
 - 7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 8. Steel Reinforcement: As required by manufacturer.

- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

- 1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

- a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Wide stile; 5-inch nominal width unless indicated otherwise.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
4. Interior Doors: Non-thermal construction.

2.4 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. Exterior Door Weather Stripping: Manufacturer's standard replaceable components.
 1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- C. Exterior Door Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

2.5 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."

2.6 MATERIALS

- A. Sheet and Plate: ASTM B209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A41 or 42, Class I, 0.018 mm or thicker.
 - 1. Color: Black.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.

- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Tolerances:
 - 1. Maximum Variation from Plumb or Level: 1/8 inch in 3 feet or 1/4 inch in any 10 feet, whichever is less.
 - 2. Maximum Misalignment of Members Abutting End to End: 1/16 inch.
- I. Coordinate attachment and seal of air and vapor barrier materials. Install sill flashings where required.
- J. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- K. Install joint filler behind sealant as recommended by sealant manufacturer.
- L. Install components plumb and true in alignment with established lines and grades.

3.2 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

3.3 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

- A. Install entrance doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

END OF SECTION 084113

SECTION 084126 - ALL-GLASS ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A Interior, all-glass entrances.
- B Interior all-glass storefronts.
- C Swinging doors.

1.02 RELATED REQUIREMENTS

- A Section 087100 - Door Hardware.

1.03 SUBMITTALS

- A Product Data: Manufacturer's descriptive literature for each component in all-glass entrance assembly.
- B Shop Drawings: Drawings showing layout, dimensions, identification of components, and interface with adjacent construction.
 - 1. Include elevations showing:
 - a. Appearance of all-glass entrance layouts.
 - b. Locations and identification of manufacturer-supplied door hardware and fittings.
 - c. Locations and sizes of cut-outs and drilled holes for other door hardware.
 - 2. Include details of:
 - a. Requirements for support and bracing at openings.
 - b. Installation details.
 - 3. Schedule: Listing of each type component in all-glass entrance assemblies, cross-referenced to shop drawing plans, elevations, and details.
- C Selection Samples: Two sets, representing manufacturer's full range of available metal materials and finishes.

1.04 QUALITY ASSURANCE

- A Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A Basis-of-Design Products: Subject to compliance with requirements, provide the named product, or the comparable product by one of the alternate specified manufacturers. Comparable products are subject to review and approval through the submittal process specified.
- B Manufacturers (All Glass Doors): Subject to compliance with requirements, provide products by one of the following:
 - 1. Rockwood (All Glass Door components)

2.02 ALL-GLASS ENTRANCES AND STOREFRONTS ASSEMBLIES

- A Entrances and Storefronts: Factory fabricated assemblies consisting of frameless glass panels fastened with metal structural fittings in configuration indicated on drawings.
- B Swinging Door Fittings and Hardware:

2.03 FITTINGS AND HARDWARE

- A Rail and Patch Style Fittings for Swinging Doors and Related Fixed Glazing:
 - 1. Top Rails: 5 inch nominal high with matching end caps.
 - 2. Bottom Patch Fittings: 3-1/2 inch nominal high by 8 inch nominal long.
 - 3. Sidelites: Match door.
 - 4. Exposed Edge Profile: Square.
- B Headers for Swinging Doors and Related Fixed Glazing:
 - 1. Dimensions: 1-3/4 inch deep by 4-1/8 inch high (44.4 mm deep by 104.7 mm high).
 - 2. Glass Thickness: 3/8 inch (9.5 mm).
- C Pivot Systems for Glass Swinging Doors:
 - 1. Pivots: Comply with BHMA A156.17.

2.04 MATERIALS

- A Glass: Flat glass meeting requirements of ASTM C1036, Type I - Transparent Flat Glass, Quality Q3, and Kind FT, fully tempered, in accordance with ASTM C1048, and as follows:
 - 1. Thickness: 3/8 inch (9.5 mm).
 - 2. Color: Class 1, Clear.
 - 3. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.
- B Sealant: One-part silicone sealant, comply with ASTM C920, clear.

2.05 ACCESSORIES

- A Exposed Fittings and Hardware: Stainless steel, brushed finish.
- B Fixed Glazed Panel Fittings: Sufficient to structurally support glazing and doors under specified loads; including but not limited to cover caps for door hardware, glazing mullions, clamp fittings, and panel corner patches.
- C Additional Door Hardware: Specified in Section 087100.

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify that openings are acceptable.
- B Do not begin installation until substrates and openings have been properly prepared.
- C If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A Clean substrates thoroughly prior to installation.
- B Prepare substrates using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A Installation of metal framing for openings as specified in Section 092116.
- B Install in accordance with manufacturer's installation instructions.
- C Tolerances:
 - 1. Horizontal Components and Sight Lines: Not more than 1/8 inch in 10 feet (3.2 mm in 3 m) variation from level, non-cumulative.
 - 2. Vertical Components and Sight Lines: Not more than 1/8 inch in 10 feet (3.2 mm in 3 m) variation from plumb, non-cumulative.
 - 3. Variation from Plane or Indicated Location: Not more than 1/16 inch (1.6 mm).
- D Installation of door hardware not supplied by entrance/storefront manufacturer as specified in Section 087100.

3.04 ADJUSTING

- A Adjust doors to operate correctly, without binding to frame, sill, or adjacent doors.
- B Adjust door hardware for smooth operation.

3.05 CLEANING

- A Clean installed work to like-new condition.

3.06 PROTECTION

- A Protect installed products until Date of Substantial Completion.
- B Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 084126

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 01 Section "General Conditions".
 - 2. Division 06 Section "Rough Carpentry".
 - 3. Division 06 Section "Finish Carpentry".
 - 4. Division 08 Section "Operations and Maintenance".
 - 5. Division 08 Section "Hollow Metal Doors and Frames".
 - 6. Division 08 Section "Flush Wood Doors".
 - 7. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 8. Division 08 Section "All-Glass Entrances".
 - 9. Division 26 Section "Electrical".
 - 10. Division 28 Section "Integrated Access Control Hardware Devices".
- D. Codes and References: Comply with the version adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.

- b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
 - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
 - D. Proof of Qualification: Provide copy of manufacturer(s) Factory Trained Installer documentation indicating proof of status as a qualified installer of tornado or hurricane storm shelter assemblies.
 - E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
 - F. Informational Submittals:
 - 1. Hurricane Resistant Openings (State of Florida): Within the State of Florida, provide copy of current State of Florida Product Approval as proof of compliance that doors, frames and hardware for exterior opening assemblies have been tested and approved for use at the wind load and design pressure and debris impact resistance level requirements specified for the Project.
 - a. Hurricane Resistant Components (State of Florida): Within the State of Florida, provide copy of independent, third party certified listing to ANSI A250.13.
 - 2. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- 1.4 CLOSEOUT SUBMITTALS
- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- 1.5 QUALITY ASSURANCE
- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
 - B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
 - C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Storm Shelter Impact Protective Assembly Installer Qualifications: Installers are to be factory trained for shop and field installation prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project. A pre-installation site inspection of the frame and floor conditions shall be conducted by the factory trained installer prior to any Storm Shelter Impact Protective assembly hardware applied to the opening.
- F. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- G. Hurricane Resistant Exterior Openings (State of Florida including the High Velocity Hurricane Zone (HVHZ)): Provide exterior door hardware as complete and tested assemblies, or component assemblies, including approved doors and frames specified under Section 081113 "Hollow Metal Doors and Frames", to meet the design pressures, debris impact resistance, and glass and glazing requirements as detailed in the current State of Florida building code sections applicable to the Project.
 - 1. Each unit to bear third party permanent label in accordance with the Florida Building Code requirements.
- H. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- I. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- J. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- K. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, or breakage.
 2. Faulty operation of the hardware.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.

- b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
- 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
- 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
- 5. Manufacturers:
 - a. McKinney Products (MK) - TA/T4A Series, 5-knuckle.

2.3 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
 - 1. Manufacturers:
 - a. Pemko Products (PE).

2.4 POWER TRANSFER DEVICES

- A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 - 1. Manufacturers:
 - a. McKinney Products (MK) - QC (# wires) Option.
- B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 - 1. Manufacturers:

- a. Securitron (SU) - EL-CEPT Series.
- C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
 - 1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney Products (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney Products (MK) - Connector Hand Tool: QC-R003.
 - 2. Manufacturers:
 - a. McKinney Products (MK) - QC-C Series.
- D. Provide mortar guard enclosure on steel frames installed at masonry openings for each electrical hinge specified.

2.5 DOOR OPERATING TRIM

- A. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 - 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 - 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 - 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 - 4. Pulls shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
 - 5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
 - 6. Manufacturers:
 - a. Rockwood Products (RO).

2.6 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
 - 1. Manufacturers:

- a. Sargent Manufacturing (SA).
 - B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 - 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 - 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Tubular deadlocks and other auxiliary locks.
 - 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 5. Keyway: Manufacturer's Patented.
 - C. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
 - 1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
 - 2. Manufacturers:
 - a. Sargent Manufacturing (SA) - Degree DG1.
 - D. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. New System: Key locks to a new key system as directed by the Owner.
 - E. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Three (3) each.
 - 2. Master Keys (per Master Key Level/Group): Five (5) each.
 - 3. Construction Keys: Ten (10) each.
 - F. Construction Keying: Provide construction master keyed cylinders.
 - G. Key Registration List (Bitting List):
 - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 - 2. Provide transcript list in writing or electronic file as directed by the Owner.
- 2.7 KEY CONTROL
- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent

markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

- a. Telkee (TK).

2.8 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide locksets with functions and features as follows:

- a. Heavy duty 12-gauge wrought steel case.
- b. Stainless steel 3/4" one-piece anti-friction reversible latchbolt with a one-piece hardened stainless steel 1" projection deadbolt.
- c. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
- d. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
- e. Meets UL Certification Directory ZHLL.R21744 for products used in windstorm rated assemblies.
- f. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.13 requirements to 16 million cycles or greater.
- g. Status indicators inside, outside, or on both sides of doors as specified; available with wording for "locked/unlocked", "vacant/occupied" or custom wording options. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status.
- h. Ten-year limited warranty for mechanical functions.

2. Electromechanical locksets shall have the following functions and features:

- a. Universal Molex plug-in connectors that have standardized color-coded wiring and are available in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
- b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
- c. Options to be available for request-to-exit or enter signaling, latchbolt and deadbolt monitoring.
- d. Optional high security monitoring with internal end-of-line monitoring alongside deadbolt privacy and integrated door position monitoring.
- e. Two-year limited warranty on electrified functions.

3. Manufacturers:

- a. Sargent Manufacturing (SA) - 8200 Series.

2.9 DEADLOCKS AND LATCHES

- A. Narrow Case Deadlocks and Deadlatches: ANSI/BHMA 156.13 Series 1000 Grade 1 narrow case deadlocks and deadlatches for swinging or sliding door applications. All functions shall be manufactured in a single sized case formed from 12 gauge minimum, corrosion resistant steel (option for fully stainless steel case and components). Provide minimum 2 7/8" throw laminated stainless steel bolt. Bottom rail deadlocks to have 3/8" diameter bolts.

1. Manufacturers:

- a. Adams Rite Manufacturing (AD) - MS1850S/MS1860 Series.

2.10 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

- B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Auxiliary Deadlocks: BHMA A156.36.
3. Dustproof Strikes: BHMA A156.16.

2.11 ELECTRIC STRIKES

- A. Standard Electric Strikes: Electric strikes conforming to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Manufacturers:

- a. HES (HS) - 1500 Series.

- B. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes conforming to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.

1. Manufacturers:

a. HES (HS) - 9600 Series.

- C. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.12 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
10. Hurricane and Storm Shelter Compliance: Devices to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate hurricane or storm shelter products that have been independently third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.

- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide exit devices with functions and features as follows:
 - a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
 - b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
 - c. No catch points: addition of applied deflectors or other added components are not allowed.
 - d. No visible plastic.
 - e. Heavy duty end caps with flush and overlapping options made of stainless steel, brass, or bronze with architectural finishes.
 - f. Constructed of all stainless steel.
 - g. Stainless steel pullman type latch with deadlock feature.
 - h. Narrow or wide style exterior trim as specified in the hardware sets.
 - i. Center case adjustability on concealed vertical rod exit devices; single operation with hex key individually adjusts top or bottom latches. No retainer screws or clips required to maintain adjustment.
 - j. Ten-year limited warranty for mechanical features.
2. Electromechanical exit devices shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. Wire routing for all non-access control electromechanical functions and EcoFlex trim to be contained within the carrier of the device eliminating the need for cavities in doors to be drilled. Include a protective film so that wires don't get damaged if the rail needs to be removed.
 - c. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - d. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
 - e. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
3. Manufacturers:
 - a. Sargent Manufacturing (SA) - PE80 Series.

2.13 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Heavy duty surface mounted door closers shall have a 30-year warranty.
 2. Manufacturers:
 - a. Sargent Manufacturing (SA) - 351 Series.
- C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.
1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 422 Series.
- 2.14 OVERHEAD CONCEALED DOOR CLOSERS
- A. Door Closers, Overhead Concealed (Narrow Profile): ANSI/BHMA 156.4 Grade 1 Certified Products Directory (CPD) listed overhead concealed door closers designed for narrow profile frames and doors. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide overhead concealed doors closers with functions and features as follows:
 - a. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies and A117.1 Accessibility Code.
 - b. Single acting, offset hung with a cast iron body.
 - c. Fully concealed body in the frame head and track assembly in the door.
 - d. Separate and independent valves for closing speed and backcheck adjustments.
 - e. Five-year limited warranty.
 2. Manufacturers:

- a. Rixson (RF) - 91DCP Series.

2.15 ARCHITECTURAL TRIM AND ACCESSORIES

- A. Door, Frame and Wall Protective Trim: ANSI/BHMA A156.6, protective products as specified in the hardware sets. Door protection plates shall be not more than 2" less than door width on stop side and 1" less door width on the pull side or on stop side of pairs of doors. Listed manufacturers shall meet all functions and features as specified herein.

- 1. Provide protective trim with functions and features as follows:
 - a. Meets ADA requirements for smooth bottom door surfaces.
 - b. UL Classified options for use on fire-rated doors up to 3 hours.
 - c. Fabricated from stainless steel, brass, bronze, aluminum, or high-impact plastic.
 - d. Available in a variety of sizes, finishes, and profiles to suit aesthetic and functional requirements.
 - e. Designed to protect doors, frames, and adjacent walls from damage due to impact, abrasion, or traffic.
 - f. Fasteners included; adhesive-backed options available for select models.
 - g. Ten-year limited warranty.
- 2. Manufacturers:
 - a. Rockwood Products (RO).

2.16 DOOR STOPS AND HOLDERS

- A. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

- 1. Manufacturers:
 - a. Rockwood Products (RO).

- B. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

- 1. Manufacturers:
 - a. Sargent Manufacturing (SA).

2.17 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko Products (PE).

2.18 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
 - 1. Manufacturers:
 - a. Securitron (SU) - DPS Series.
- B. Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 - 1. Power supplies shall meet all functions and features as specified herein.
 - a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
 - b. Tolerates brownout or overvoltage input $\pm 15\%$ of nominal voltage.

- c. Thermal shutdown protection with auto restart.
- d. Circuit breaker protection against overcurrent and reverse battery faults.
- e. Integrated battery charging circuit to prevent overvoltage on locking devices.
- f. Available with a single relay fire trigger or individually triggered relayed outputs.
- g. Monitoring options as specified.

2. Manufacturers:

- a. Securitron (SU) - AQD Series.

2.19 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.20 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Paint prime coated mullions to match frames.
- C. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- D. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- E. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- F. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- G. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handing and sizing all products.
 - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

Set: 1 - Exterior Entry

Doors: 100.1

2	Continuous Hinge	CFM95SLF-HD1		PE	
1	Power Transfer (For active leaf of pair only)	EL-CEPT	630	SU	⚡
1	ElectroLynx Harness (Install between power transfer and junction box)	QC-C1500P		MK	⚡
1	Electric Latch Retraction Exit Device (Fail x P106 x less pull x Secure)	US32D DG1 x MK x 24VDC	21 56 LD ADPE8410 F SA		⚡
1	ElectroLynx Harness	QC-CXXX x required length		MK	⚡
1	Exit Device	LD ADPE8410 F	US32D	SA	
2	Pull	RM3311 x 12" x Type 12XHD mounting	US32D	RO	
2	Overhead Concealed Closer	91N x 90 deg	626	NO	
1	Threshold	2005 AT x DOW x MS & ES25		PE	
2	Door Bottom Seal	345 AV x DOW		PE	
1	Astragal (Set)	(2) 297 AS x DOH		PE	
1	Drip Strip	346 C x DOW + 4"		PE	
1	Card Reader	Furnished and installed by security contractor			OT
2	Door Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD4		SU	⚡
1	Wiring Diagram	WD-SYSPK		SA	

Aluminum Windstorm door and frame

Hardware listed for design criteria, confirm with specific door manufacturer hardware requirements to meet specified Windstorm rating and provide third party test results for confirmation

Gasketing furnished by frame manufacturer

Card reader to be used by authorized persons to gain entry from the exterior side of the opening

Card reader to be used to retract the latch of the electric latch retraction exit device

Push bar of the exit devices always free for immediate egress

Set: 2 - Corridor/Sim Center

Doors: 100.2, 100.3, 113.1

Refer to Section 084125 for all hardware

Set: 3 - Not used

Set: 4 - Dressing

Doors: 101A

4	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	
1	Privacy Set & Indicator	8265 LNP x EMB x V21	US26D	SA	
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO	
1	Wall Stop	406	US32D	RO	
3	Silencer	608-RKW		RO	

Set: 5 - Storage

Doors: 101B, 145A,

4 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lockset	21 8204 LNP x DG1 x MK	US26D	SA
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Door Stop	481	US26D	RO
3 Silencer	608-RKW		RO

Set: 6 - Interior Storefront Swinging Door

Doors: 102, 103, 104, 105, 106, 107, 115, 116, 117, 120, 121, 122, 123, 124, 125, 128, 129, 130

All hardware furnished by door manufacturer

Set: 7 - Group Toilet

Doors: 108, 109, 140, 142

4 Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Push Plate	84 10 x 20	US32D	BU
1 Pull Plate	110 x 70C 4 x 16	US32D	RO
1 Closer	422 CTB2	EN	SA
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 8 - Utility

Doors: 110, 143

4 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lockset	21 8204 LNP x DG1 x MK	US26D	SA
1 Electric Strike	1500C x 2004M x 24VDC	630	HS ⚡
1 ElectroLynx Harness	QC-C1500P'		MK ⚡
<i>(Install between electric strike and junction box)</i>			
1 Closer	351 O	EN	SA
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO
1 Card Reader	Furnished and installed by security contractor		OT
1 Door Position Switch	DPS-W-BK	SU	⚡
1 Power Supply	AQD4	SU	⚡
1 Wiring Diagram	WD-SYSPK		SA

Card reader to be used by authorized persons to gain entry from the push side of the opening
Card reader to be used to activate the electric strike

Set: 9 - Lounge

Doors: 111, 112,

1 Push/Pull	(2) RM3301 x 12" x Type 5HD mounting	US32D-316 RO	
1 Wall Stop	406	US32D	RO

Balance of hardware furnished by partition manufacturer

Set: 10 - IT

Doors: 148,

7 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	
1 Electric Hinge	TA2714 4-1/2" x 4-1/2" QC-12	US26D	MK	⚡
<i>(Install at second from bottom hinge-active leaf only)</i>				
1 ElectroLynx Harness	QC-C1500P		MK	⚡
<i>(Install between electric hinge and junction box)</i>				
1 Mortar Box	MG-16	US2C	MK	
1 Electrified Lockset (Fail Secure)	21 NAC-82271 LNP x DG1 x MK x 24VDC	US26D	SA	⚡
1 ElectroLynx Harness	QC-CXXX x required length		MK	⚡
<i>(Install between electric hinge and electrified exit device)</i>				
1 Flush Bolt (Top)	555 x 24"	US26D	RO	
1 Flush Bolt	555 x 12"	US26D	RO	
1 Dust Proof Strike	570	US26D	RO	
1 Closer	351 O	EN	SA	
<i>(For active leaf of pair only)</i>				
2 Kickplate	K1050 10" x 1" LDW 4BE CSK	US32D	RO	
2 Door Stop	481	US26D	RO	
2 Silencer	608-RKW		RO	
1 Astragal	355 CS x DOH		PE	
1 Card Reader	Furnished and installed by security contractor			OT
1 Door Position Switch	DPS-W-BK		SU	⚡
<i>(For inactive leaf of pair only)</i>				
1 Power Supply	AQD4		SU	⚡
1 Wiring Diagram	WD-SYSPK		SA	

Card reader to be used by authorized persons to gain entry from the push side of the opening
Card reader to be used to unlock the push side lever of the electrified lockset
Pull side lever of the electrified lockset always free for immediate egress

Set: 11 - Sim Center

Doors: 113.2

4 Hinge	T4A3786 5" x 4-1/2" NRP	US26D	MK	
1 Storeroom Lockset	21 8204 LNP x DG1 x MK	US26D	SA	
1 Electric Strike	1500C x 2004M x 24VDC	630	HS	⚡
1 ElectroLynx Harness	QC-C1500P'		MK	⚡
<i>(Install between electric strike and junction box)</i>				
1 Closer	351 P10	EN	SA	
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO	
1 Wall Stop	406	US32D	RO	
3 Silencer	608-RKW		RO	
1 Card Reader	Furnished and installed by security contractor			OT
1 Door Position Switch	DPS-W-BK		SU	⚡
1 Power Supply	AQD4		SU	⚡
1 Wiring Diagram	WD-SYSPK		SA	

Card reader to be used by authorized persons to gain entry from the pull side of the opening
Card reader to be used to activate the electric strike

Set: 12 - Debrief/Lounge/Office

Doors: 113A, 113C, 144A, 144B, 144C, 144D, 144E, 144F

1 Office Lockset	21 8205 LNP x DG1 x MK	US26D	SA
1 Wall Stop	406	US32D	RO

Balance of hardware furnished by partition manufacturer

Set: 13 - Computer/Moulage/Sim

Doors: 113B.1, 113D, 113E, 113H

4 Hinge	T4A3786 5" x 4-1/2"	US26D	MK
1 Office Lockset	21 8205 LNP x DG1 x MK	US26D	SA
1 Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
<i>(For door 113B, 113E and 113H only)</i>			
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 14 - Control/Workroom

Doors: 113F, 113G, 113I

4 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Office Lockset	21 8205 LNP x DG1 x MK	US26D	SA
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 15 - Exterior Study

Doors: 114

2 Continuous Hinge	CFM101SLF-HD1		PE
1 Exit Device	21 LD ADPE8410 J x P106 x less pull x DG1 x		US32D
SA			
	MK		
1 Exit Device	LD ADPE8410 J	US32D	SA
2 Pull	RM3311 x 12" x Type 12XHD mounting	US32D	RO
2 Overhead Concealed Closer	91N x 90 deg	626	NO
1 Threshold	2005 AT x DOW x MS & ES25		PE
2 Door Bottom Seal	345 AV x DOW		PE
1 Astragal (Set)	(2) 297 AS x DOH		PE
1 Drip Strip	346 C x DOW + 4"		PE
2 Door Position Switch	DPS-M-BK		SU

Aluminum Windstorm door and frame

Hardware listed for design criteria, confirm with specific door manufacturer hardware requirements to meet

specified Windstorm rating and provide third party test results for confirmation

Gasketing furnished by frame manufacturer

Set: 16 - Classroom

Doors: 118, 119, 126, 127

4 Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Security Classroom Lockset	21 8238 LNP x DG1 x MK	US26D	SA
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 17 - Classroom

Doors: 131, 132, 133

4 Hinge	T4A3786 5" x 4-1/2"	US26D	MK
1 Security Classroom Lockset	21 8238 LNP x DG1 x MK	US26D	SA
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
1 Overhead Stop	698S	US26D	SA
3 Silencer	608-RKW		RO

Set: 18 - Corridor Storage

Doors: 134, 136, 113B.2, 148A, 151A

4 Hinge	T4A3786 5" x 4-1/2"	US26D	MK
1 Storeroom Lockset	21 8204 LNP x DG1 x MK	US26D	SA
1 Closer	351 O	EN	SA
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
1 Gasketing (Set)	S88 BL x DOW x DOH		PE

Set: 19 - Test

Doors: 135

4 Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Security Classroom Lockset	21 8238 LNP x DG1 x MK	US26D	SA
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Overhead Stop	698S	US26D	SA
3 Silencer	608-RKW		RO

Set: 20 - Corridor Toilet/Mothers Room

Doors: 137, 138, 139

4 Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Set & Indicator	8265 LNP x EMB x V21	US26D	SA
1 Closer	422 CTB2	EN	SA
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 21 - Janitor

Doors: 141

4 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lockset	21 8204 LNP x DG1 x MK	US26D	SA
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 22 - Administration

Doors: 144.1

7 Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US26D	MK	
1 Electric Hinge	T4A3786 4-1/2" x 4-1/2" QC-12	US26D	MK	⚡
<i>(Install at second from bottom hinge-active leaf only)</i>				
1 ElectroLynx Harness	QC-C1500P		MK	⚡
<i>(Install between electric hinge and junction box)</i>				
1 Mortar Box	MG-16	US2C	MK	
1 Electrified Exit Device (Fail Secure)	LD NB-PE8774 F x P774-8 NEP x 24VDC	US32D	SA	⚡
1 ElectroLynx Harness	QC-CXXX x required length		MK	⚡
<i>(Install between electric hinge and electrified exit device)</i>				
1 Exit Device	LD NB-PE8710 F x 710 NEP	US32D	SA	
2 Closer	351 P10	EN	SA	
2 Kickplate	K1050 10" x 1" LDW 4BE CSK	US32D	RO	
2 Wall Stop	406	US32D	RO	
2 Silencer	608-RKW		RO	
1 Card Reader	Furnished and installed by security contractor			OT
2 Door Position Switch	DPS-W-BK		SU	⚡
1 Power Supply	AQD4		SU	⚡
1 Wiring Diagram	WD-SYSPK		SA	

Card reader to be used by authorized persons to gain entry from the pull side of the opening
Card reader to be used to unlock the pull side lever of the electrified exit device
Push bar of the exit devices always free for immediate egress

Set: 23 - Administration

Doors: 144.2

4 Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US26D	MK	
1 Exit Device	21 LD PE8804 F x 704 NEP x DG1 x MK	US32D	SA	
1 Electric Strike	9600 x 2004M x 24VDC	630	HS	⚡
1 ElectroLynx Harness	QC-C1500P'		MK	⚡
<i>(Install between electric strike and junction box)</i>				
1 Closer/Stop	351 CPS	EN	SA	
1 Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO	
3 Silencer	608-RKW		RO	
1 Card Reader	Furnished and installed by security contractor			OT
1 Door Position Switch	DPS-W-BK		SU	⚡
1 Power Supply	AQD4		SU	⚡
1 Wiring Diagram	WD-SYSPK		SA	

Card reader to be used by authorized persons to gain entry from the pull side of the opening
Card reader to be used to activate the electric strike

Set: 24 - Call/Conference/Meeting

Doors: 146, 147, 149, 150

1 Passage Set	8215 LNP	US26D	SA
1 Wall Stop	406	US32D	RO
1 Door Stop	481	US26D	RO

(Fo door 146 and 147 only)

Balance of hardware furnished by partition manufacturer

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass products.
 - 2. Glazing sealants.
 - 3. Glazing tapes.
 - 4. Miscellaneous glazing materials.
- B. Related Requirements:
 - 1. Section 084126 "All-Glass Entrances and Storefronts."

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Product Test Reports: For fabricated glass, for tests performed by a qualified testing agency.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.8 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
 - 1. Design Wind Pressures: As indicated on Drawings.
 - 2. Design Snow Loads: As indicated on Drawings.
 - 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 - 4. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
 - 2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with

NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.

3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.2 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- D. Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.

2.4 GLAZING SEALANTS

- A. General:
 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by

- sealant manufacturer based on testing and field experience.
- 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- B. Neutral-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.
 - 1. Applications: Non-rated Interior Applications.
- C. Acid-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.
 - 1. Applications: Non-rated Interior Applications.

2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
 - 1. Elastomeric with Shore A durometer hardness of 85, plus or minus 5.
 - 2. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
 - 1. Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 - 2. Type recommended in writing by sealant or glass manufacturer.

- E. Edge Blocks:
 - 1. Elastomeric with Shore A durometer hardness per manufacturer's written instructions.
 - 2. Type recommended in writing by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch- minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.

- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type G2: Clear Fully Tempered safety float glass
 - 1. Minimum Thickness: 1/4"
 - 2. Safety Glazing required.
- B. Glass Type G3: Clear fully tempered safety float glass.
 - 1. Minimum thickness: 3/8"
 - 2. Safety glazing required

END OF SECTION

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonstructural steel framing.
 - 2. Grid suspension systems.
- B. Related Requirements:
 - 1. Section 092900 – Gypsum Board.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of nonstructural steel framing and fastening and anchorage details.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, and attachments to adjoining work.

1.3 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Track: Provide documentation that framing members are certified in accordance with product-certification program of the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Where indicated on Drawings, provide assemblies incorporating nonstructural steel framing identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: Where indicated on Drawings, provide assemblies incorporating nonstructural framing identical to those of assemblies tested in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
- C. Horizontal Deflection: For composite wall assemblies, limited to 1/360 of the wall height based on the following horizontal loading:
 - 1. Horizontal Loading: 5 lbf/sq. ft.

2.2 NONSTRUCTURAL STEEL FRAMING

- A. Framing Members, General: Comply with requirements in AISI S220 for conditions

indicated on Drawings.

1. Protective Coating: ASTM A653/A653M, G40 hot-dip galvanized or coating with demonstrated equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Equivalent Corrosion-Resistant Coating: Evaluation report acceptable to authorities having jurisdiction demonstrates corrosion resistance equivalent to specified protective coating.
- B. Studs and Track: Conventional members, roll-formed into standard shapes without surface deformations to stiffen framing members.
 1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
 2. Minimum Yield Strength: 33 ksi.
 3. Depth: [As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated on Drawings.
 1. Slotted Deflection Track: Steel sheet top track manufactured with deep flanges that allow positive attachments to studs through long slots and prevent deflection of structure above from cracking finishes applied to framing in base-steel thickness not less than that of studs and in width to accommodate depth of studs.
 - a. Flange Length: 2-1/2 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, substrates, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 1. Furnish concrete inserts and other devices required to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling track to surfaces indicated on Drawings to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of nonstructural steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated on Drawings. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION OF NONSTRUCTURAL METAL FRAMING, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING

- A. Install framing system components at spacings indicated on Drawings, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated on Drawings.
 - 2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated on Drawings.
 - 3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated on Drawings.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install track at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated on Drawings to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated on Drawings.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

- c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure unless otherwise indicated on Drawings.
- 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated on Drawings. Install framing below sills of openings to match framing required above door heads.
- 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated on Drawings and support closures to make partitions continuous from floor to underside of solid structure.
- 5. STC-Rated Partitions: Install framing to comply with STC-rated assembly indicated on Drawings.
- 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of at least two studs at ends of arcs, place studs 6 inches o.c.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Wall-Furring Bracket Systems: Install brackets with serrated edges facing upward spaced at minimum 48 inches o.c. vertically with 6 inches maximum from floor and ceiling, and minimum 36 inches o.c. horizontally with 4 inches maximum from abutting construction, unless otherwise indicated on Drawings.
- G. Suspended Assemblies: Isolate suspension assemblies from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
 - 1. Hangers: Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - c. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

- d. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
- e. Do not attach hangers to steel roof deck.
- f. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
- g. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
- h. Do not connect or suspend framing from ducts, pipes, or conduit.
- 2. Carrying Channels (Main Runners): U-channels spaced as indicated on Drawings.
- 3. Furring Channels (Furring Members): Rigid hat-shaped furring channels.
 - a. Spacing: As indicated on Drawings
 - b. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- 4. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- H. Installation Tolerances for Nonstructural Steel Framing:
 - 1. Framing Members: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.
 - 2. Suspended Assemblies: Install suspension systems that are level to within 1/8 inch in 12 ft. measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLATION OF GRID SUSPENSION SYSTEMS

- A. Grid Suspension Systems: Install in accordance with manufacturer's written instructions. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- B. Installation Tolerances for Grid Suspension Systems: Install suspension systems that are level to within 1/8 inch in 12 ft. measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
 - 3. Trim accessories.
- B. Related Requirements:
 - 1. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
 - 2. Section 092216 "Non-Structural Metal Framing" for nonstructural steel framing and suspension systems that support gypsum board panels.
 - 3. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Locations and installation of control and expansion joints, including plans, elevations, sections, and attachment details.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings in accordance with ASTM E119; tested by a qualified testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings in accordance with ASTM E90 and classified in accordance with ASTM E413; tested by a qualified testing agency.

2.2 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed; SAINT-GOBAIN
 - b. Georgia-Pacific Gypsum LLC
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company
 - d. PABCO Gypsum
 - e. USG Corporation
2. Thickness: As indicated on Drawings.
3. Long Edges: Tapered.
- B. Gypsum Ceiling Board: ASTM C1396/C1396M.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Georgia-Pacific Gypsum LLC
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company
 - d. PABCO Gypsum
 - e. USG Corporation
 2. Thickness: 1/2 inch.
 3. Long Edges: Tapered.
- C. Acoustically Enhanced Gypsum Board: ASTM C1766; multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Gold Bond Building Products, LLC provided by National Gypsum Company
 - c. PABCO Gypsum
 2. Core: As indicated on Drawings.
 3. Long Edges: Tapered.

2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. James Hardie Building Products, Inc.
 - b. PermaBASE Building Products, LLC provided by National Gypsum Company
 - c. USG Corporation
 2. Thickness: As indicated on Drawings.
 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 1. Material: Galvanized-steel sheet or aluminum-coated steel sheet, rolled zinc,

- plastic, or paper-faced galvanized-steel sheet.
- 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated on Drawings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brand X Metals, Inc
 - b. Flannery, Inc.
 - c. Fry Reglet Corporation
 - d. Gordon Inc.
 - e. Pittcon Industries
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
 - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M requirements.
 - 1. Mold-Resistant Joint Compound: Use mold-resistant formulations with mold-resistant panel products.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 4. Tile Backing Panels: As recommended in writing by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended in writing by backing panel manufacturer.
 - 2. Cementitious Backer Units: As recommended in writing by backer unit manufacturer.
 - 3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended in writing by manufacturer for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise specified or indicated on Drawings.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended in writing by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers as follows:
 - 1. Non-Fire-Resistance-Rated Assemblies: Glass or slag or rock wool.
 - 2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840 requirements.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 requirements and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound-attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Gypsum Wallboard: Vertical surfaces unless otherwise indicated.
 - 2. Gypsum Ceiling Board: Ceiling surfaces.
 - 3. Acoustically Enhanced Gypsum Board: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated on Drawings.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing)

unless otherwise specified or indicated on Drawings or required by fire-resistance-rated assembly, and minimize end joints.

- a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated on Drawings or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim in accordance with manufacturer's written instructions.
- B. Control Joints: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Install at outside corners.
 2. LC-Bead: Install at exposed panel edges.
 3. Base-of-Wall PVC Moisture Barrier Trim: Install at base of wall.

3.6 APPLICATION OF JOINT TREATMENT MATERIALS

- A. Finishing Panel Products: Treat joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare panel surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, beveled edges, and damaged surface areas.
- C. Apply joint tape over panel joints, except for trim products specifically indicated as not intended to receive tape.
- D. Interior Gypsum Board: Finish panels to levels indicated below and in accordance with ASTM C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 3:
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

- 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- 5. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Glass-Mat Faced Panels: Finish in accordance with manufacturer's written instructions.
- F. Cementitious Backer Units: Finish in accordance with manufacturer's written instructions.

3.7 PROTECTION

- A. Protect adjacent surfaces from joint compound and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board installation and finishing.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceramic tile.
 - 2. Waterproof membranes.
 - 3. Crack isolation membranes.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.
 - 2. Section 092900 "Gypsum Board" for tile backing panels.

1.2 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium) 2019.
- B. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.4 ACTION SUBMITTALS

- A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories for each type of product. Include instructions for using grouts and adhesives.
- B. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory for each color and finish required.
 - 3. Metal flooring transitions 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Grade Certificate: Certify that products meet or exceed specified requirements.
- B. Master Grade Certificates: For each type of tile, signed by the tile manufacturer and tile installer.
- C. Installer's Qualification Statement.
- D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:

1. Company specializing in performing tile installation, with minimum five years of documented experience.
2. Installer is a Five-Star member of the National Tile Contractors Association, a Trowel of Excellence member of the Tile Contractors' Association of America.
3. Installer Certification:
 - a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
 - b. International Masonry Training and Education Foundation (IMTEF): Supervisor Certification Program (SCP).

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

- A. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Tile: Obtain tile of each type and color or finish from single source or producer.
 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from a single source or producer.
 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from a single manufacturer.
 2. Obtain waterproof membrane and crack isolation membrane, except for sheer products, from a manufacturer of setting and grout materials.
- C. Other Products: Obtain each of the products specified in this Section from a single manufacturer.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 1. Provide tile complying with Standard Grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Tile: As indicated on the Drawings.

2.3 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
 - 1. Applications: As indicated.
 - 2. Manufacturers: Same as for tile.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; nickel silver or stainless steel, ASTM A276 or ASTM A666, 300 Series exposed-edge material.
 - 1. Manufacturers:
 - a. Blanke Corporation
 - b. Ceramic Tool Company, Inc.
 - c. Schluter-Systems
 - d. Genesis APS International

2.4 SETTING MATERIALS

- A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
- B. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
 - 1. Products:
 - a. ARDEX Engineered Cements; S 28.
 - b. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer.
 - c. LATICRETE International, Inc; MULTIMAX LITE
 - d. TEC, an H.B. Fuller Construction Products Brand; TEC 3N1 Performance Mortar.

2.5 GROUT MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. ARDEX Engineered Cements.
 - 2. Bostik Inc.
- C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Color(s): As indicated on drawings.
 - 2. Products:
 - a. ARDEX Engineered Cements; ARDEX WA.
 - b. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout.
 - c. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout.
 - d. Mapei Corporation; Kerapoxy.
 - e. TEC, an H.B. Fuller Construction Products Brand; TEC AccuColor EFX Epoxy Special Effects Grout.

2.6 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Waterproof and Crack Isolation Membrane: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
 - 1. Waterproof Membrane, Fluid-Applied: Liquid-latex rubber or elastomeric polymer.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; RedGuard.
 - b. HB Fuller Construction Products Inc.; TEX Hydraflex.
 - c. Laticrete International, Inc.; Laticrete; Hydro Ban.
 - d. MAPEI Corporation; Mapelastic AquaDefense.
 - e. Sika Corporation; SikaTile Moisture Guard 100.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
- D. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of setting materials to subfloor surfaces.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

- A. Joining Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- B. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- C. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Install non-ceramic trim in accordance with manufacturers instructions.
- F. Keep control and expansion joints free of mortar, grout and adhesive.
- G. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- H. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- I. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- J. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. TCNA F115: Thinset mortar; epoxy grout.
 - a. Ceramic Tile Type: As indicated on Drawings.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
 - 2. TCNA F122: Thinset mortar on waterproof membrane.
 - a. Ceramic Tile Type: As indicated on Drawings.
 - b. Thinset Mortar Improved modified dry-set mortar.
 - c. Grout Water-cleanable epoxy grout.
 - 3. TCNA F125: Thinset mortar on crack isolation membrane.
 - a. Ceramic Tile Type: As indicated on Drawings.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Metal Studs or Furring:

1. TCNA W244C or TCNA W244F: Thinset mortar on cementitious backer units or fiber-cement backer board.
 - a. Ceramic Tile Type
 - 1) Thinset Mortar Improved-modified dry-set mortar.
 - 2) Grout Water-cleanable epoxy grout.

END OF SECTION

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Acoustical tiles.

1.2 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.

1.4 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to during, and after acoustical unit installation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Maintenance Stock: Under this Section furnish to the Owner prior to final acceptance, extra maintenance stock of acoustical materials, consisting of a minimum of one percent of area for each size, type, thickness installed on the job, and 4% if the area is under 5,000 sq. ft. This extra stock is for the Owner's use after completion of the Project and is not to be used for repair or replacement required during construction period. Properly package, seal and identify extra stock material.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.2 ACOUSTICAL TILES

- A. Acoustical Tiles:
 - 1. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
 - 2. Basis of Design: Subject to compliance with requirements provide the products as indicated on Drawings, or comparable products from the acceptable

manufacturers indicated.

2.3 SUSPENSION SYSTEMS

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, clips, and splices as required .
 - 1. Materials:
 - a. Steel Grid: ASTM A635/A635M, G30 coating, unless otherwise indicated.
- B. Exposed Suspension Systems: Hot-dipped galvanized steel grid with aluminum cap.
 - 1. Structural Classification" Intermediate-duty, when testing in accordance with ASTM C635/C635M.
 - 2. Profile: Tee; 15/16 inch (24 mm) face unless indicated otherwise.
 - 3. Finish: Baked enamel.
 - 4. Color: White unless indicated otherwise.

2.4 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12-gage 0.08 inch (2mm) galvanized steel wire, ASTM A641
- C. Retention Clips at Impact Resistant Ceilings: Manufacturer's standard retention clips designed and spaced to secure acoustical tiles in-place against vandalism in public areas (i.e. corridors, classrooms and similar type rooms, student toilet rooms, locker rooms, vestibules, etc.)
- D. Perimeter Moldings: Same metal and finish as grid.
 - 1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
- E. Acoustical Insulation: ASTM C665 friction fit type, unfaced batts.
 - 1. Thickness: 4 inch.
- F. Touch-Up Paint: Type and color to match acoustical and grid units.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.3 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C363/C363M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Locate system on room axis according to reflected ceiling plan.
- E. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions
 - 1. Install in bed of acoustical sealant
 - 2. Use longest practical lengths.
 - 3. Do not use exposed fasteners, including pop rivets, on molding and trim.
- F. Suspension System: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches (152mm) of each corner, or support components independently.
- J. Do not eccentrically load system or induce rotation of runners.

3.4 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- F. Where round obstructions occur, provide preformed closures to match perimeter molding.
- G. Lay acoustical insulation for a distance of 48 inches (1219mm) either side of acoustical partitions as indicated.
- H. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

- I. Install hold-down clips on panels within 20 ft (6m) of an exterior door.

3.5 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3mm in 3m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1. Vinyl base.

1.2 ACTION SUBMITTALS

- A. Product Data: Provide data on specified product, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions for each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 4 inches long.
- C. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing specified flooring with minimum five years documented experience.

1.4 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 - PRODUCTS

2.1 VINYL BASE

- A. Lengths: Cut lengths 48 inches long, Coils in manufacturer's standard length.
- B. Outside Corners: Preformed.
- C. Inside Corners: Preformed.
- D. Products: As indicated on Drawings.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Vinyl Moldings, Transition and Edge Strips: Include vinyl cap for cove resilient floor covering, carpet edge for glue-down applications, nosing for resilient floor covering,

reducer strip for resilient floor covering, joiner for tile and carpet, transition strips.

- D. Locations: Provide vinyl molding accessories in areas indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to manufacturer, free of cracks that might telegraph through product, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of product to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.2 PREPARATION

- A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP)
- B. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.
- E. Prohibit traffic until filler is fully cured.
- F. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 RESILIENT BASE INSTALLATION

- A. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
1. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- C. Preformed Corners: Install preformed corners before installing straight pieces.
- D. Install base on solid backing. Bond tightly to wall and floor surfaces.
- E. Scribe and fit to door frames and other interruptions.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Remove excess adhesive from floor, base, and wall surfaces without damage.
- C. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid vinyl floor tile.

1.2 ACTION SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions for each type of product.
- B. Samples for Verification: Full-size units of each exposed product and for each color and pattern of floor tile required.
- C. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.4 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:
 - 1. 48 hours before installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

PART 2 - PRODUCTS

2.1 SOLID VINYL FLOOR TILE

- A. Products: As indicated on Drawings.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile

manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
- C. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve a smooth, flat, hard surface.
- D. Prohibit traffic until filler is fully cured.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.
- F. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 FLOOR TILE INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Comply with manufacturer's written instructions for installing floor tile.
- C. Adhesive-Applied Installation:
 - 1. Fit joints and butt seams tightly.
 - 2. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Resilient Strips: Attach to substrate using adhesive.

- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- G. Install flooring in recessed floor access covers, maintaining floor pattern.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Remove excess adhesive from floor, base and wall surfaces without damage.
- C. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1. Carpet tile.

1.2 ACTION SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- B. Samples for Verification: Actual sample of finished products for each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet Tile: Full-size Sample.
 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 10 sq. yd..

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

PART 2 - PRODUCTS

2.1 TILE CARPETING

- A. Products: As indicated on Drawings.

2.2 MATERIALS

- A. Tile Carpeting: Tufted, manufactured in one color dye lot.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended in writing by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive types to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and that are recommended in writing by carpet tile manufacturer for releasable installation.
- C. Edge Strips: Embossed aluminum, color as selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.
- C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- D. Concrete Slabs: Verify that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

3.2 PREPARATION

- A. General: Comply with CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, in accordance with manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended in writing by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- I. Trim carpet tile neatly at walls and around interruptions.
- J. Complete installation of edge strips, concealed exposed edges.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive without damage, from floor, base, and wall surfaces.
 - 2. Clean and vacuum carpet surfaces.
- B. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Textile wall covering.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches long in size.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire-Growth Contribution: No flashover and heat and smoke release when tested in accordance with NFPA 265.

2.2 TEXTILE WALL COVERING

- A. Basis of Design: As indicated on Drawings.

2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099123 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.
- C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer

manufacturer and wall-covering manufacturer.

2. Painted Surfaces:
 - a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
 - b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERING

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
 1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

SECTION 098433
SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sound-absorbing wall panels.

1.2 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include fabric facing, panel edge, core material, and mounting indicated.
- B. Shop Drawings: For unit assembly and installation.
 - 1. Include plans, elevations, sections, and mounting devices and details.
 - 2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
 - 3. Include details at cutouts and penetrations for other work.
 - 4. Include direction of fabric weave and pattern matching.
- C. Samples for Verification: For the following products:
 - 1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
 - 2. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.
 - 3. Core Material: 12-inch- square Sample at corner.
 - 4. Mounting Devices: Full-size Samples.
 - 5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Elevations 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. Electrical outlets, switches, and thermostats.
 - 2. Items penetrating or covered by units including the following:
 - a. Lighting fixtures.

- b. Air outlets and inlets.
 - c. Speakers.
 - d. Alarms.
 - e. Sprinklers.
 - f. Access panels.
- 3. Show operation of hinged and sliding components covered by or adjacent to units.
- B. Product Certificates: For each type of unit.
- C. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a lighting level of not less than 50 fc is provided on surfaces to receive the units.
- C. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to the following:
 - a. Acoustical performance.
 - b. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units to comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

2.2 SOUND-ABSORBING WALL UNITS

- A. Product: As indicated on drawings.
- B. Baffle Core: Manufacturer's standard rigid or semi-rigid fiberglass core.
- C. Mounting: As indicated on drawings.

2.3 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
 - 1. Thickness.
 - 2. Overall length and width.
 - 3. Squareness from corner to corner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials in accordance with manufacturer's written instructions.

END OF SECTION 098433

SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Steel and iron.
 - 2. Gypsum board.

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Sherwin Williams Company
 - 3. PPG Paints
- B. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- C. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- D. Colors: As indicated in a color schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Wood: 15 percent.
 - 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory

primed or factory finished if acceptable to topcoat manufacturers.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Wood Substrates: Wood trim, and Architectural woodwork.
 - 1. Water-based varnish over stain system MPI INT 6.3W;
 - a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90
 - b. First Intermediate Coat: Water-based varnish matching topcoat.
 - c. Second Intermediate Coat: Water-based varnish matching topcoat
 - d. Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI

#129

2. Water-Based Varnish system MPI INT 6.3Q:
 - a. Prime Coat: Water-based varnish matching topcoat
 - b. Intermediate Coat: Water-based varnish matching topcoat
 - c. Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI #129
- B. Gypsum Board and Plaster Substrates:
 1. Latex over Latex Sealer System, MPI INT 9.2A:
 - a. Prime Coat:
 - 1) Primer sealer, latex, interior, MPI #50.
 - 2) Latex, interior, matching topcoat.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat:
 - 1) Latex, interior, flat (MPI Gloss Level 1), MPI #53.
 - 2) Latex, interior (MPI Gloss Level 3), MPI #52.
 - a) Use MPI Gloss Level 3 where not specified on drawings.

END OF SECTION

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Visual display board assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Visual display board assemblies.
- B. Product Data Submittals: For each product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- C. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
 - 3. Show locations and layout of special-purpose graphics.
 - 4. Include sections of typical trim members.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each visual display unit, for tests performed by a qualified testing agency.
- C. Sample Warranties: For manufacturer's special warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 2. Warranty Period:
 - a. 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLIES

- A. Visual Display Board Assembly: factory fabricated.
1. Assembly: markerboard.
 2. Corners: Square.
 3. Width: As indicated on Drawings.
 4. Height: As indicated on Drawings.
 5. Mounting Method: Manufacturers standard mounting method.
- B. Markerboard Panel: Porcelain-enamel steel markerboard panel on core indicated.
1. Color: White.
- C. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; standard size and shape.
1. Aluminum Finish: Clear anodic finish.
- D. Marker Tray: Provide (1) 12" magnetic marker tray, with set of 4 markers and an eraser at elevations less than 20 ft. in total length. Provide (2) 12" magnetic marker trays, each with a set of 4 markers and an eraser at elevations longer than 20 ft. in total length.

2.3 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
- B. Basis of Design: Porcelain-enamel steel writing surface by Claridge; LCS Elite Frameless Porcelain Markerboard.

2.4 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Porcelain-Enamel Steel Writing Surface: Projectable surface with low reflectivity.
- C. Extruded Aluminum: ASTM B221, Alloy 6063.
- D. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
- E. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 099123 "Interior Painting" and recommended in writing by visual display unit manufacturer for intended substrate.
- F. Fasteners: Provide fasteners of non-magnetic stainless steel or other materials warranted by the manufacturer to be non corrosive and compatible with steel and aluminum components.
 - 1. Exposed fasteners shall not be used.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are 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.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display units.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Panel signs.
 - 2. Field-applied, vinyl-character signs.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Panel signs.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Panel Signs: Full-size Sample.
 - 2. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- E. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

1.3 FIELD CONDITIONS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the ADA Standards for Accessible Design and ICC A117.1.

2.2 PANEL SIGNS

- A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Takeform signage per schedule or comparable product.

2. Interior Panel Signs: Provide smooth sign panel surfaces construction to remain flat under installed conditions within a tolerance of plus or minus 1/16" measured diagonally from corner to corner, complying with requirements as indicated on Drawings.
 - a. Materials, Sizes and Text: As indicated on Drawings.
 - b. Mounting: Unframed
 - 1) Wall mounted with concealed anchors or two-face tape.
 - 2) Manufacturer's standard anchors for substrates encountered
 - c. Color: As indicated on Drawings
 - d. Evacuation Map signs shall have a unique "you are here" orientation as well as two emergency egress paths.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
 1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
- B. Adhesive: As recommended by sign manufacturer.

2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's

written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessible Signage: Install in locations on walls as indicated on Drawings.
- C. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign and two-face tape.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Phenolic-core toilet compartments.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for blocking.
 - 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 ACTION SUBMITTALS

- A. Product Data.
 - 1. Phenolic-core toilet compartments.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachment details.
 - 2. Show locations of cutouts for compartment-mounted toilet accessories.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show locations of floor drains.
- C. Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.
 - 1. Size: Manufacturers' standard size.
- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For toilet compartments.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Hinges: One hinge(s) with associated fasteners.
 - 2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
 - 3. Door Bumper: One door bumper(s) with associated fasteners.
 - 4. Door Pull: One door pull(s) with associated fasteners.
 - 5. Fasteners: 10 fasteners of each size and type.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate

before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Toilet-Enclosure Style: Floor anchored.
- B. Urinal-Screen Style: Wall hung.
- C. Door, Panel, and Pilaster Construction: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch-thick doors and pilasters and minimum 1/2-inch-thick panels. Provide no-sightline system. **[Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).]**
- D. Urinal-Screen Construction: Matching panel construction.
- E. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- F. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- G. Urinal-Screen Post: Manufacturer's standard post design of **[monolithic phenolic-core urinal screen cutout at bottom to form a post][material matching the thickness and construction of pilasters][or][1-3/4-inch-square, aluminum tube with satin finish]**; with shoe **[and sleeve (cap)]** matching that on the pilaster.
- H. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, stainless steel.
 - 2. Full-Height (Continuous) Type: Manufacturer's standard design, stainless steel.
- I. Phenolic Compartment Finish: One color in each room.
 - 1. Through-Color Phenolic: Manufacturer's standard solid through-color.
 - a. Color: As selected by Architect from manufacturer's full range.

2.3 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories. **[Mount with through bolts.]**
 - 1. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.
 - 2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for

- emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at outswinging doors.
 5. Door Pull: Manufacturer's standard stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: ASTM B221.
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies at posts and walls, with leveling adjustment nuts at **[tops and]** bottoms of posts. Provide shoes **[and sleeves (caps)]** at posts to conceal anchorage.
- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, inswinging doors for standard toilet enclosures and 36-inch- wide, outswinging doors with a minimum 32-inch- wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels or Screens: 1/2 inch.
 - b. Panels or Screens and Walls: 1 inch.
 - 2. Stirrup Brackets: Secure panels or screens to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
 - 3. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

SECTION 102123 - CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cubicle-curtain support systems.
 - 2. Cubicle curtains.

1.2 ACTION SUBMITTALS

- A. Product Data Submittals: For each product.
- B. Shop Drawings: For curtains and tracks.
 - 1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
- C. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:
 - 1. Curtain Fabric: Not less than 12 inches square and showing complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For curtains, tracks, and hardware to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 CUBICLE-CURTAIN SUPPORT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Construction Specialties, Inc.
 - 2. inpro Corporation
 - 3. Tubular Specialties Manufacturing, Inc.
- B. Curtain-Track Mounting: Surface.
- C. Curtain-Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
- D. Curtain Roller Carriers: Two nylon rollers and nylon axle with steel hook.
- E. Curtain Glide Carriers: One-piece nylon glide with steel hook.

2.2 CUBICLE CURTAINS

- A. Fabric: As indicated on Drawings.
- B. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.
- C. Flame spread index of 25, maximum; smoke development index of 450, maximum; when tested in accordance with ASTM E84.
- D. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test
 - 1. Identify fabrics with appropriate markings of a qualified testing agency.
- E. Laundering: Launderable to a water temperature of not less than 160 deg. F
- F. Mesh Top: Not less than 20-inch- high mesh top.
 - 1. Mesh: No. 50 nylon mesh.
- G. Snap Attachments: Provide manufacturer's standard nickel-plated brass snap attachments for modular panels.
- H. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.3 CURTAIN FABRICATION

- A. Continuous Curtain Panels:
 - 1. Width: Equal to track length from which curtain is hung plus 10 percent of added fullness, but not less than 12 inches of added fullness.
 - 2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 15 inches.
 - 3. Mesh Top: Top hem of mesh not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lockstitched. Double lockstitch bottom of mesh directly to 1/2-inch triple thickness, top hem of curtain fabric.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install tracks level and plumb, according to manufacturer's written instructions.
- B. For tracks of up to 20 feet in length, provide track fabricated from single, continuous length.
 - 1. Curtain-Track Mounting: Surface.
- C. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

- D. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.

END OF SECTION

SECTION 102219 - DEMOUNTABLE PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A Site assembled demountable partitions.

1.02 SUBMITTALS

- A Product Data: For each type of product.
- B Shop Drawings: Indicate layout, module joint locations, and special details associated with acoustic seals.
 - 1. Include diagrams for power-, signal-, and control-wiring raceways.
- C Samples: For each exposed product and for each color and texture specified

1.03 INFORMATIONAL SUBMITTALS

- A Installer's Qualification Statement.
- B Product certificates.
- C Product test reports.

1.04 QUALITY ASSURANCE

- A Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B Acoustical Performance: Where acoustical rating is indicated, provide demountable-partition assembly tested by a qualified testing agency for sound transmission loss performance according to ASTM E90, calculated according to ASTM E413, and rated for not less than the STC value indicated.

2.02 MANUFACTURERS

- A Demountable Glass Partitions Basis of Design: Zona 1 Glass Wall Systems Subject to compliance with requirements, provide one of the following, or comparable substitution subject to approval by the Architect.
 - 1. Zona Glass Wall Systems: Zona 1 Single Glazed System
 - 2. Dynamic Hive: Single Glass System

2.03 DEMOUNTABLE GLASS PARTITIONS

- A Partition System: Demountable, single dry glazed, non-progressive, capable of four direction lateral expansion with reusable components.
 - 1. Trim: Continuous, factory-finished, snap-on type; adjustable for variations in floor and ceiling levels.
 - a. Exposed-Metal Trim Finish: Clear-anodized aluminum.
 - 2. Doors: Glass doors as indicated on Drawings
 - a. Construction: Manufacturer's standard 1-3/4-inch-thick.
 - b. Door Operation: As indicated on drawings.
 - c. Door Finish: Clear-anodized aluminum.
 - 3. Door Frames: Manufacturer's standard aluminum frames for 1-3/4-inch doors.
 - a. Frame Finish: Clear-anodized aluminum.
 - 4. Door Hardware: As selected by Architect from manufacturer's full range.
 - 5. Glazing Frames: Manufacturer's standard aluminum frames for frameless (top and bottom-supported) glazing thickness indicated.
 - a. Frame Finish: Clear-anodized aluminum.
 - 6. Glazing: Manufacturer's standard fully tempered clear float glass.

2.04 MATERIALS

- A Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B Glazing:
 - 1. Tempered Glass: Annealed flat glass meeting requirements of ASTM C1036, Type 1-Transparent Flat, Class 1-Clear, Quality Q3, and fully tempered in accordance with ASTM C1048, Kind FT.
 - a. Thickness: 3/8 inch minimum.
 - b. Prepare glazing panels for indicated fittings and hardware before tempering.
 - c. Provide exposed glazing edges with flat polished/ground glass finish.
 - d. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.
- C Fasteners: Type recommended by system manufacturer.

- D Panel Adhesive: Type recommended by system manufacturer.

2.05 FABRICATION

- A General: Fabricate demountable walls for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor coverings. Fabricate systems for installation with continuous seals at floor, ceiling, and other locations where partitions abut fixed construction.
- B Panels for Site-Assembled Demountable Partitions: Face panels fabricated and finished in modular widths indicated.
 - 1. Factory glaze panels to the greatest extent possible.

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify that building conditions are ready to receive partitions and that field measured dimensions are as required by the partition system manufacturer.
- B Verify that required utilities are available, in proper location, and ready for use.

3.02 INSTALLATION

- A Install demountable partitions after other finishing operations have been completed.
 - 1. Install partitions rigid, level, plumb, and aligned. Install seals at connections with floors, ceilings, fixed walls, and abutting surfaces to prevent light and sound transmission.
 - 2. Except for filler panels scribed to fixed walls or columns, do not modify manufacturer's standard components.
- B Partition Panels:
 - 1. Install panels in accordance with partition system manufacturer's instructions.
 - 2. Install panels in vertical direction; locate ends and edges over rigid support.
- C Frames: Install in accordance with partition system manufacturer's instructions; erect vertical members plumb, and horizontal members level.
- D Doors: Install in accordance with partition system manufacturer's instructions; hang to fit square within frame and to swing freely, without binding.
- E Door Hardware: Install in accordance with partition system manufacturer's instructions.
- F Glazing: Install in accordance with partition system manufacturer's instructions.

3.03 TOLERANCES

- A Maximum Variation from True Plane of Partition Surfaces: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.
- B Maximum Variation from Dimensioned Locations: 1/4 inch (6 mm) in any direction.

3.04 ADJUSTING

- A Inspect installation, correct misalignments, and tighten loose connections.
- B Adjust doors and frames to provide smooth door operation from open to closed position without gravity movement of door from any position.
- C Remove and replace defaced or damaged components.

3.05 DEMONSTRATION

- A Train Owner's maintenance personnel to adjust, assemble, disassemble, and maintain demountable partitions.

3.06 PROTECTION

- A Do not permit subsequent construction activities to cause damage to appearance or operation of installed partition components before Date of Substantial Completion.

END OF SECTION 102219

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall guards.
 - 2. Corner guards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
 - 1. Corner Guards: 12 inches long. Include example top caps.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of exposed plastic material.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, standard length units.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1.

2.2 CORNER GUARDS

- A. Surface-Mounted, Plastic-Cover Corner Guards: As indicated on Drawings.
 - 1. Comparable substitutions may be acceptable subject approval of the Architect.

2.3 FABRICATION

- A. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.4 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

SECTION 102800 - TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A Public-use washroom accessories.
- B Private-use bathroom accessories.
- C Childcare accessories.
- D Custodial accessories.

1.02 SUBMITTALS

- A Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- B Samples: For each exposed product and for each finish specified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A Commercial Toilet, Shower, and Bath Accessories:

2.02 COMMERCIAL TOILET ACCESSORIES

- A Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B Toilet Tissue (Roll) Dispenser **(TD-1)**:
 - 1. Basis of Design: Bobrick Washroom Accessories B3588
 - 2. Description: Double-roll dispenser.
 - 3. Mounting: Surface mounted.
 - 4. Operation: Noncontrol delivery with theft-resistant spindle.
 - 5. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
 - 6. Material and Finish: Stainless steel, No. 4 finish (satin).
- C Automatic Paper Towel (Roll) Dispenser **(PT-1)**:
 - 1. Basis of Design: Georgia Pacific; EnMotion No. 59446
 - 2. Description: Automatic motion sensing mechanism with user-adjustable delay and paper towel length.
 - 3. Mounting: Semi-recessed.
 - 4. Minimum Capacity: 10-inch- wide, 1 roll.

5. Material and Finish: Stainless steel, No. 4 finish (satin).
 6. Power: Batteries
- D Automatic Liquid-Soap Dispenser **(SD-1)**:
1. Basis of Design: Purell; LTX12-12
 2. Description: Automatic dispenser with infrared sensor to detect presence of hands; designed for dispensing soap in liquid or lotion form.
 3. Mounting: Wall mounted.
 4. Capacity: 1200 mL.
 5. Power: Batteries.
 6. Materials: Chrome finish.
- E Grab Bar **(GB)**
1. Basis of Design: Bobrick Washroom Accessories B-5806
 2. Mounting: Flanges with concealed fasteners.
 3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin).
 4. Outside Diameter: 1-1/4 inches (32 mm).
 5. Configuration and Length: As indicated on Drawings.
- F Sanitary-Napkin Disposal Unit **(SN-1)**:
1. Basis of Design: Bobrick Washroom Accessories B-270
 2. Mounting: Surface mounted.
 3. Door or Cover: Self-closing, disposal-opening cover.
 4. Receptacle: Removable.
 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- G Mirror Unit **(MR-1)**
1. Frame: Frameless with Stainless Steel J-channel top and bottom mounting
 - a. Corners: Grounded Smooth
 - b. Hanging: Mechanically fasten J-channel and adhere mirror.
 - c. Size: As indicated on Drawings.
 2. Material:
 - Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- H Mirror Unit **(MR-2)**: Full length
1. Frame: Frameless with Stainless Steel J-channel top and bottom mounting
 - a. Corners: Grounded Smooth
 - b. Hanging: Mechanically fasten J-channel and adhere mirror.
 2. Size: As indicated on Drawings.
 3. Material:

- a. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I Garment Hook **(GH-1)**:

- 1. Basis of Design: Bobrick Washroom Accessories B-7672
- 2. Description: Double-prong unit.
- 3. Material and Finish: Stainless steel bright polished

J Seat-Cover Dispenser **(CD-1)**:

- 1. Basis-of-Design: Bobrick Washroom Accessories B-4221.
- 2. Mounting: Surface mounted.
- 3. Minimum Capacity: 250 seat covers.
- 4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
- 5. Lockset: Tumbler type.

2.03 UTILITY ROOM ACCESSORIES

- A Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.

- 1. Basis of Design: Bobrick Washroom Accessories B-239x34
- 2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
- 3. Length: Manufacturer's standard length for number of holders/hooks.

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify exact location of accessories for installation.
- B For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- C Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

- A Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B Install plumb and level, securely and rigidly anchored to substrate.
- C Grab Bars: Install to withstand a downward load of at least 250 lb ft, when tested according to ASTM F 446.

3.03 ADJUSTING AND CLEANING

- A Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B Remove temporary labels and protective coatings.
- C Clean and polish exposed surfaces according to manufacturer's written instructions.

3.04 PROTECTION

- A Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguisher.
- B. Related Requirements:
 - 1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets.
 - 1. Include plans, elevations, sections, details, and attachments to other work.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 FIRE-PROTECTION CABINET

- A. Fire-Protection Cabinet Type: Suitable for fire extinguisher.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Cold-rolled steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame

overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
- E. Cabinet Trim Material: Same material and finish as door.
- F. Door Material: Steel sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 1. Provide projecting lever handle with cam-action latch.
 2. Provide continuous hinge, of same material and finish as trim,, permitting door to open 180 degrees.
- J. Accessories:
 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to glazing.
 - 2) Application Process: Silk-screened or Decals.
 - 3) Lettering Color: White.
 - 4) Orientation: Vertical.
- K. Materials:
 1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: White.
 2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Miter corners and grind smooth.

3. Provide factory-drilled mounting holes.
 4. Prepare doors and frames to receive locks.
 5. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION OF FIRE-PROTECTION CABINETS

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:
1. Fire-Protection Cabinet Mounting Height: As indicated on drawings.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
1. Provide inside latch and lock for break-glass panels.
 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification:

1. Apply decals,/vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.
- B. Related Requirements:
 - 1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

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. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
 - b. Faulty operation of valves or release levers.
 - 2. 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 indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ansul; brand of Johnson Controls International plc, Building Solutions North America]
 - b. Buckeye Fire Equipment Company
 - c. JL Industries; Activar Construction Products Group, Inc.
 - 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
 - 3. Valves: Manufacturer's standard.
 - 4. Handles and Levers: Manufacturer's standard.
 - 5. 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. Multipurpose Dry-Chemical Type : UL-rated 3-A: 40 B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION

SECTION 113013 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cooking appliances.
 - 2. Refrigeration appliances.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Cooking appliances.
 - 2. Refrigeration appliances.
- B. Product Data Submittals: For each product.
 - 1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

1.3 WARRANTY

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction.

2.2 COOKING APPLIANCES

- A. Microwave Oven. **MO-1:**
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sharp; R-21LCFS Medium Duty Commercial Microwave Oven.
 - 2. Mounting: Countertop.
 - 3. Dimensions:

- a. Width: 21 inches.
 - b. Depth: 16 inches.
 - c. Height: 12 inches.
4. Capacity: 1 cu. ft..
5. Oven Door: Door with observation window and pull handle.
6. Microwave Power Rating: 1000 W.
7. Electric Power Supply: 120 V.
8. Other Features: Dial Timer.
9. Material: Stainless steel.

2.3 REFRIGERATION APPLIANCES

- A. Large Refrigerator: Side by side refrigerator. **RF-1:**
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Kratos Refrigeration; Model 69K-773, 2 Solid Door Reach-in Refrigerator.
 2. Type: Side by side.
 3. Dimensions:
 - a. Width: 54-1/8 inches.
 - b. Depth: 33-3/8 inches.
 - c. Height: 83-1/2 inches.
 4. Storage Capacity:
 - a. Refrigeration Compartment Volume: 42.9 cu. ft..
 - b. Shelf Area: 6 adjustable wire shelves.
 5. General Features:
 - a. Integral condensate evaporator.
 6. Refrigerator Features:
 - a. Interior light in refrigeration compartment.
 - b. Digital temperature controls.
 7. Appliance Color/Finish: Stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with

concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 CLEANING

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

END OF SECTION

SECTION 122400 - WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A Interior manual roller shades.

1.02 ACTION SUBMITTALS

- A Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- B Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
- C Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.

1.03 INFORMATIONAL SUBMITTALS

- A Product Certificates: For each type of shadeband material.
- B Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.04 CLOSEOUT SUBMITTALS

- A Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

1.05 QUALITY ASSURANCE

- A Installer Qualifications: Fabricator of products.

1.06 DELIVERY, STORAGE, AND HANDLING

- A Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B Handle and store shades in accordance with manufacturer's recommendations.

1.07 FIELD CONDITIONS

- A Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A Basis of Design: Match existing roller shade and housing in existing building.
- B Source Limitations: Obtain roller shades from single source from single manufacturer.

2.02 ROLLER SHADE FABRICATION

- A Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B Field measure finished openings prior to ordering or fabrication.
- C Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window stool.
- D At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.
- E Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 EXECUTION

3.01 EXAMINATION

- A Examine finished openings for deficiencies that may preclude satisfactory installation.
- B If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C Start of installation shall be considered acceptance of substrates.

3.02 INSTALLATION

- A Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.03 CLEANING

- A Clean soiled shades and exposed components as recommended by manufacturer.

3.04 CLOSEOUT ACTIVITIES

- A Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION 122400

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.
 - 4. Solid surface material apron fronts.
- B. Related Requirements:
 - 1. Section 064116 – Plastic-Laminate-Clad Architectural Cabinets

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Initial Selection: For each type of material exposed to view.
- D. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

2.2 FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Countertops:
 - 1. 1/2-inch- thick, solid surface material.
- C. Backsplashes: 1/2-inch- thick, solid surface material with wood-trimmed edges.
- D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- E. Joints:
 - 1. Fabricate countertops without joints.
 - 2. Fabricate countertops in sections for joining in field, with joints at locations indicated.
 - a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
- F. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION

DIVISION 21 – FIRE SUPPRESSION

SECTION 210500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 SCOPE

- A. The Advertisement for Bid, Instructions to Bidders, Bidding Requirements, General, Special and Supplementary Conditions, and all other Contract Documents shall apply to the Contractor's work as well as to each of their Sub-Contractor's work.
- B. All manufacturers, suppliers, fabricators, contractors, etc. submitting proposals for any part of the work, services, materials or equipment to be used on or applied to this project are hereby directed to familiarize themselves with the Contract Documents. In case of conflict between these General Provisions and the General and/or Special Conditions, the Contractor shall contact the Engineer for clarification and final determination prior to the Bid.
- C. The work included in this Division consists of the furnishing of all labor, equipment, transportation, excavation, backfill, supplies, material, appurtenances and services necessary for the satisfactory installation of the complete and operating Fire Suppression Systems indicated or specified in the Contract Documents.
- D. Any materials, labor, equipment or services not mentioned specifically herein which may be necessary to complete any part of the Fire Suppression Systems in a substantial manner, in compliance with the requirements stated, implied or intended in the Plans and/or Specifications, shall be included in the Bid as part of this Contract.
- E. It is not the intent of this Section of the Specifications to make any Contractor, other than the Prime Contractor responsible to the Owner. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be routed through the General Contractor to the Architect, then to the Engineer. Also, this Section of the Specifications shall not be construed as an attempt to arbitrarily assign responsibility of work, material, equipment or services to a particular trade or Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be optional.
- F. The Architect and Engineer do not define the scope of individual trades, subcontractors, material suppliers and vendors. Any sheet numbering system or specification numbering system used which identifies disciplines is solely for the Architect and Engineer's convenience and is not intended to define a subcontractor's scope of work. Information regarding individual trades, subcontractors, material suppliers and vendors may be detailed, described and indicated at different locations throughout the Contract Documents. No consideration will be given to requests for change orders for failure to obtain and review the complete set of Contract Documents when preparing Bids, prices and quotations. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be the responsibility of the Contractor holding the prime contract.
- G. It is the intent of the Contract Documents to deliver to the Owner a new, complete and operational project once the work is complete. Although Plans and Specifications are complete to the extent possible, it shall be the responsibility of the Contractors involved to remove and/or relocate or re-attach any existing or new

systems which interfere with new equipment or materials required for the complete installation without additional cost to the Owner.

- H. In general, all work shall be accomplished without interruption of existing facilities operations. The Contractor shall advise the Owner at least seven (7) days prior to the interruption of any services (gas, domestic water, heating, etc.). The Owner shall be advised of the exact time that interruption will occur and the length of time the interruption will last. Failure to comply with this requirement may result in complete work stoppage for the Contractors involved until a complete schedule of interruptions can be developed.
- I. Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore said service. The Contractor shall provide tools, materials, skilled journeymen of Bidder/Proposer's own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without requests for extra compensation from the Owner.
- J. Each Bidder/Proposer shall also be governed by any unit prices and Addenda insofar as they may affect part of their work or services.

1.3 DEFINITIONS AND ABBREVIATIONS:

- A. Contractor - Any Contractor whether bidding, proposing or working independently or under the supervision of a General Contractor, Prime Contractor, Construction Manager and who installs any type of Mechanical Work as specified in the Contract Documents or, the General Contractor.
- B. Engineer - The Consulting Mechanical-Electrical Engineer either consulting to the Owner, Architect, or Other, etc. In this case: CMTA, Inc., Consulting Engineers.
- C. Architect - The Architect of Record for the project.
- D. Contract Documents - All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Contract with Owner, etc.
- E. Bidder/Proposer - Any person, agency or entity submitting a proposal to any person, agency or entity for any part of the work required under this contract.
- F. The Project - All of the work required under this Contract.
- G. Furnish - Deliver to the site in good condition and turn over to the Contractor who is to install.
- H. Provide - Furnish and install complete, tested and ready for operation.
- I. Install - Receive and place in satisfactory operation.
- J. Indicated - Listed in the Specifications, shown on the Plans or Addenda thereto.
- K. Typical or Typ.- Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.
- L. ADA - Americans with Disabilities Act.
- M. ANSI - American National Standards Institute.
- N. ASME - American Society of Mechanical Engineers.
- O. IBC - International Building Code.
- P. NEC - National Electrical Code.
- Q. NEMA - National Electrical Manufacturers Association.
- R. NFPA - National Fire Protection Association.
- S. OSHA - Office of Safety and Health Administration.
- T. UL - Underwriters Laboratories.

1.4 INTENT AND INTERPRETATION:

- A. It is the intention of the Contract Documents to call for a complete and operational system, including all components, accessories, finish work, etc as necessary for trouble free operation; tested and ready for operation. Anything that may be required, implied, or inferred by the Contract Documents shall be provided and included as part of the Bid.

- B. All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- C. Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
- D. The Bidder/Proposer shall completely review the Contract Documents. Any interpretation as to design intent or scope shall be provided by the Engineer / Architect. Should an interpretation be required, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event of any conflict, discrepancy, or inconsistency develops; the interpretation of the Engineer shall be final.
- E. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten (10) days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in the bid, and that will be responsible for the approved satisfactory functioning of the entire system without extra compensations.

1.5 INDEMNIFICATION:

- A. The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

1.6 PLANS AND SPECIFICATIONS:

- A. The Plans are diagrammatic only and indicate the general arrangement of the systems and are to be followed. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Engineer for approval before proceeding with the work. The Plans are not intended to show every item which may be necessary to complete the systems. All Bidder/Proposers shall anticipate that additional items may be required and submit their Bid accordingly.
- B. The Plans and Specifications are intended to supplement each other. No Bidder/Proposer shall take advantage of conflict between them, or between parts of either. Should this condition exist, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be final.
- C. The Plans and Specifications shall be considered to be cooperative and anything appearing in the Specifications which may not be indicated on the Plans or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
- D. Contractor shall make all of their own measurements in the field and shall be responsible for correct fitting. The work shall be coordinated with all other branches of work in such a manner as to cause a minimum of conflict or delay.

- E. The Engineer shall reserve the right to make adjustments in location of piping, ductwork, equipment, etc. where such adjustments are in the interest of improving the project.
 - F. Should conflict, overlap or duplication of work between the various trades become evident, this shall be called to the attention of the Engineer. In such event neither trade shall assume to be relieved of the work which is specified under their branch until instructions in writing are received from the Engineer.
 - G. Unless dimensioned, the Plans only indicate approximate locations of equipment, piping, etc. Dimensions given in figures on the Plans shall take precedence over scaled dimensions and all dimensions, whether given in figures or scaled, shall be verified in the field to ensure no conflict with other work.
 - H. Each Bidder/Proposer shall review all Plans in the Contract Documents to ensure that the work they intend to provide does not create a conflict with or affect the work of others in any way. Where such effect does occur it shall be the Bidder/Proposer's responsibility to satisfactorily eliminate any such conflict or effect prior to the submission of their proposal. Each Bidder/Proposer shall in particular ensure that there is adequate space to install their equipment and materials. Failure to do so shall result in the correction of such encroachment conflict or effect of any work awarded the Bidder/Proposer and shall be accomplished fully without expense to others and that they are reasonably accessible for maintenance. Check closely all mechanical and electrical closets, chases, ceiling voids, wall voids, crawl spaces, etc., to ensure adequate spaces.
 - I. Where on the Plans a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornamentation or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.
 - J. Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
 - K. Where within the Contract Documents the word "typical" or "typ." is used, it shall mean that the work method or means indicated as typical shall be repeated in and each time it occurs whether indicated or not.
 - L. Each Contractor shall evaluate ceiling heights specified on Architectural Plans. Where the location of equipment or systems may interfere with ceiling heights or maintenance and access of equipment or systems, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Do not install equipment or systems in the affected area until the conflict is resolved. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work or cost incurred on the part of the Contractor or unduly delay the work.
 - M. The Contractor shall provide a layout confirmation of equipment rooms to verify that all of the equipment submitted and approved will in fact fit into the proposed space and have adequate clearance for service. See COORDINATION DRAWINGS SECTION.
- 1.7 EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS:
- A. When any Contractor requests approval of materials and/or equipment of different physical size, weight, capacity, function, color, access, that the design allows for it shall be understood that such substitution, if approved, will be made without additional cost to anyone other than the Contractor requesting the change regardless of changes in connections, space requirements, electrical characteristics, etc. from that indicated, electrical service, etc. In all cases where substitutions affect other trades, the Contractor requesting such substitutions shall advise all such Contractors of the change and shall compensate them for all necessary changes in their work. Any Plans, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Review of Shop Drawings by the Engineer does not in any way absolve the Contractor of this responsibility.

- B. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; any devices, products, materials, fixtures, forms, or types of construction which, in the judgment of the Engineer, are equivalent to those specified are acceptable, provided the provisions of this Part are met. Requested substitutions shall be submitted to the Engineer a minimum of ten (10) days prior to Bid. If this procedure is not followed, the substitution will be rejected. If prevailing laws of cities, towns, states or countries are more stringent than these specifications regarding such substitutions, then those laws shall prevail over these requirements.
- C. Wherever any equipment and material is specified exclusively only such items shall be used unless substitution is accepted in writing by the Engineer.
- D. Each Bidder/Proposer shall furnish along with their proposal a list of specified equipment and materials which is to be provided. Where several makes are mentioned in the Specifications and the Contractor fails to state which they propose to furnish, the Engineer shall choose any of the makes mentioned without change in price. Inclusion in this list shall not ensure that the Engineer will approve shop drawings unless the equipment, materials, etc., submitted in shop drawings are satisfactorily comparable to the items specified and/or indicated.

1.8 QUALIFICATIONS OF CONTRACTOR/WORKERS:

- A. All Contractors and their subcontractors bidding this project must have been a licensed company for a minimum of three (3) years to qualify to Bid this project. Individual employee experience does not supercede this requirement.
- B. All fire suppression subcontractors bidding the fire suppression scope of work must have completed one project of 70% this subcontract cost size and two projects of 50% this subcontract cost size.
- C. All fire suppression work shall be accomplished by qualified workers competent in the area of work for which they are responsible. Untrained and incompetent workers, as evidenced by their workmanship, shall be summarily relieved of their responsibilities in areas of incompetency. The Engineer shall reserve the right to determine the quality of workmanship of any workers and unqualified or incompetent workers shall refrain from work in areas not deemed satisfactory. Requests for relief of workers shall be made through the normal channels of Architect, Contractor, etc.
- D. The Contractor shall hold all required licenses in the State which the work is to be performed.
- E. All special systems (Automatic Sprinkler Equipment, etc.) shall be installed only by workers normally engaged in such services. Exception to this specification may only be made in writing by the Engineer.
- F. All electrical work shall be accomplished by Licensed Journeymen electricians under the direct supervision of a licensed Electrician. All applicable codes, utility company regulations, laws and permitting authority of the locality shall be fully complied with by the Contractor.

1.9 HAZARDOUS MATERIALS:

- A. The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building or site.
- B. Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of their work, ensure that their workers are aware of this potential and what they are to do in the event of suspicion. The Contractor shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall ensure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.

- C. CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling or disposal of such material.
- D. If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner and so advise them immediately.
- E. The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.
- F. No asbestos or mercury containing materials shall be installed in this project.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 EXAMINATION OF SITE AND CONDITIONS:

- A. Each Bidder/Proposer shall inform themselves of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, above and below grade, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work.
- B. Each Bidder/Proposer shall also fully acquaint themselves with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of utilities, etc. A proposal shall cover all expenses or disbursements in connection with such matters and conditions. No allowance will be made for lack of knowledge concerning such conditions after Bids are accepted.

3.2 CODES, RULES, PERMITS, FEES, INSPECTIONS, REGULATIONS, ETC.:

- A. The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, inspections and other costs, including all utility connections, meters, meter settings, taps, tap fees, extensions, etc. in connection with their work. They shall also file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments and/or the appropriate municipality or utility company having jurisdiction, whether indicated or specified or not. They shall also obtain all required certificates of inspection for their work and deliver same to the Engineer before request for acceptance and final payment for the work.
- B. Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.
- C. The Contractor shall include in their work, without extra cost, any labor, materials, services, apparatus and Plans in order to comply with all applicable laws, ordinances, rules and regulations, whether or not indicated or specified.
- D. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, with the requirements of local utility companies, or municipalities and with the requirements of all governmental agencies having jurisdiction.

- E. All materials and equipment so indicated and all equipment and materials for the electrical portion of the mechanical systems shall bear the approval label of, or shall be listed by the Underwriters' Laboratories (UL), Incorporated. Each packaged assembly shall be approved as a package. Approval of components of a package shall not be acceptable.
- F. The Contractor shall furnish three (3) copies of all Final Inspection Certificates obtained to the Engineer when work is complete. Final payment for work will be contingent upon compliance with this requirement.
- G. Where minimum code requirements are exceeded in the Design, the Design shall govern.
- H. The Contractor shall ensure that their work is accomplished in accord with the OHSA Standards and that they conduct their work and the work of their personnel in accord with same.
- I. Work in elevators, elevator shafts and elevator equipment rooms shall comply with the Elevator Code enforced by the Authority Having Jurisdiction.
- J. Discharge of any toxic, odorous or otherwise noxious materials into the atmosphere or any system shall be subject to regulations of the Environmental Protection Agency (EPA) and/or the air pollution control commission. If in doubt, contact the State Department for Environmental Protection.
- K. Where conflict arises between any code and the Plans and/or Specifications, the code shall apply except in the instance where the Plans and Specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten (10) days prior to bid date, otherwise the Contractor shall make the required changes at their own expense.

3.3 SUPERVISION OF WORK:

- A. The Contractor shall personally supervise the work for which they are responsible or have a competent superintendent, approved by the Engineer, on the work at all times during progress with full authority to act on behalf of the Contractor.

3.4 CONDUCT OF WORKERS:

- A. The Contractor shall be responsible for the conduct of all workers under their supervision. Misconduct on the part of any worker to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt removal of that worker. The consumption of alcoholic beverages or other intoxicants, narcotics, barbiturates, hallucinogens or debilitating drugs on the job site is strictly forbidden.

3.5 COOPERATION AND COORDINATION WITH OTHER TRADES:

- A. The Contractor shall give full cooperation to all other trades and shall furnish in writing with copies to the Engineer, any information necessary to permit the work of other trades to be installed satisfactorily and with the least possible interference or delay.
- B. Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than $\frac{1}{4}" = 1'-0"$, clearly indicating how their work is to be installed in relation to the work of other trades, or so as not to cause any interference with work of other trades. Make the necessary changes in the work to correct the condition without extra charge.
- C. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

3.6 GUARANTEES AND WARRANTIES:

- A. The Contractor shall guarantee all equipment, apparatus, materials, and workmanship entering into their Contract to the best of its respective kind and shall replace all parts at their own expense, which are proven defective within the time frame outlined in the General Conditions of the Contract. The effective date of completion of the work shall be the date of the Project's Statement of Substantial Completion. Items of equipment which have longer guarantees, as called for in these Specifications, shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Engineer shall then submit these warranties, etc. to the Owner. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall not invalidate the guarantee except that the Owner shall be liable for any damage to equipment during this period, due to negligence of their operator or other employees. Refer to other sections for any special or extra warranty requirements.
- B. Provide all warranty certificates to Owner. All warranties begin starting at the substantial completion date, submit warranty certificates accordingly.

3.7 COST BREAKDOWNS (SCHEDULE OF VALUES):

- A. Within thirty (30) days after acceptance of the Contract, the Contractor shall furnish to the Engineer, one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made in a format approved by the Engineer. Payments will not be made until satisfactory cost breakdowns are submitted.
- B. The breakdown shall be minimally as follows. Material and labor shall be listed separately. Pay special attention to required withholding percentages for startup, testing, documentation, acceptance, owner training, etc.:
 - 1. Shop Drawings
 - 2. Motor Load Coordination with Other Subcontractors
 - 3. Record Drawings & Acceptance
 - 4. Owner Training & Acceptance
 - 5. Identification Materials & Labor
 - 6. Piping Materials & Labor
 - 7. Piping Materials & Labor
 - 8. Fire Protection Shop Drawings
 - 9. Fire Protection Materials & Labor
 - 10. Fire Protection Record Drawings & Acceptance
 - 11. Other Equipment and Labor
 - 12. Other Equipment Startup, Testing, Documentation, Training, Acceptance, etc.

12.8 CHANGES IN FIRE PROTECTION WORK:

- A. REFER TO GENERAL AND SPECIAL CONDITIONS.

12.9 CLAIMS FOR EXTRA COST:

- A. REFER TO GENERAL AND SPECIAL CONDITIONS.

12.10 MATERIALS AND WORKMANSHIP:

- A. All equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. Each Bidder/Proposer shall determine that the materials and/or equipment they propose to furnish can be brought into the building(s) and installed within the space available. In certain cases, it may be necessary to remove and replace walls, floors and/or ceilings and/or disassemble/reassemble the materials and equipment and this work shall be the responsibility of the Contractor, whether specifically initiated or not.

- B. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement of fans, motors, coils, filters, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s). Ensure, through coordination that no other Contractor seals off access to space required for equipment materials, etc.
- C. Materials and equipment shall bear Underwriters' Laboratories label where such a standard has been established, where applicable.
- D. Each length of pipe, fitting, trap, fixture and device used in the plumbing or drainage systems shall be stamped or indelibly marked with the weight or quality thereof and with the manufacturer's mark or name.

12.11 TEMPORARY SERVICES:

- A. The Contractor shall arrange any temporary water, electrical and other services which may be required to accomplish the work. Refer also to General and Special Conditions.
- B. All temporary services shall be removed by Contractor prior to completion of work.

12.12 SURVEY, MEASUREMENTS AND GRADE:

- A. The Contractor shall lay out their work and be responsible for all necessary lines, levels, inverts, elevations and measurements. The Contractor must verify the figures shown on the Plans before laying out the work and will be held responsible for any error resulting from failure to do so.
- B. The Contractor shall base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.
- C. Should the Contractor discover any discrepancy between actual measurements and those indicated which prevents following good practice or the intent of the contract documents, the Contractor shall promptly notify the Engineer and shall not proceed with this work until the Contractor has received instructions from the Engineer on the disposition of the work.

12.13 PROTECTION OF EQUIPMENT:

- A. The Contractor shall be entirely responsible for all material and equipment they furnish in connection with their work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. All piping, etc., shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged, stolen or vandalized while stored on site, either before or after installation, shall be repaired or replaced by the Contractor at their expense.

3.14 REQUIRED CLEARANCES FOR ELECTRICAL EQUIPMENT:

- A. The NEC has specific required clearances above, in front, and around electrical gear, panels etc. The Contractor shall not install any piping, equipment, etc., in the required clearance. If any appurtenance is located in the NEC required clearance, it shall be relocated at no additional cost. Coordinate with the Electrical Contractor prior to any work.

3.15 EQUIPMENT SUPPORT:

- A. Each piece of equipment, apparatus, piping, or conduit suspended from the ceiling or mounted above the floor level shall be provided with suitable structural support, pipe stand, platform or carrier in accordance with the best recognized practice. Such supporting or mounting means shall be provided by the Contractor for all equipment and piping. Exercise extreme care that structural members of building are not overloaded

by such equipment. Provide any required additional bracing, cross members, angles, support, etc. Do not support items from roof/floor deck or bridging.

3.16 PIPE MOUNTING HEIGHTS:

- A. All exposed or concealed equipment, piping, etc., shall be held as high as possible unless otherwise noted and coordinated with all other trades. Exposed piping shall, insofar as possible, run perpendicular or parallel to the building structure. Refer to Plans for minimum heights of ducts and piping. Minimum height above ceilings shall be 6" clear including insulation, unless otherwise noted.

3.17 BROKEN LINES AND PROTECTION AGAINST FREEZING:

- A. No conduits, piping, etc. carrying water or any other fluid subject to freezing shall be installed in any part of the building where danger of freezing may exist without adequate protection being given by the Contractor whether or not insulation is specified or indicated on the particular piping. All damages resulting from broken and/or leaking lines shall be replaced or repaired at the Contractor's own expense. Do not install piping across or near openings to the outside whether or not they are carrying static or moving fluids. Insulation on piping does not necessarily ensure that freezing will not occur. If in doubt, contact the Engineer.

3.18 WEATHERPROOFING:

- A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as specified and approved by the Architect and Engineer before work is performed. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings permanently watertight.
- B. Wherever work penetrates roofing, it shall be done in a manner that will not diminish or void the roofing guarantee or warranty in any way. Coordinate all such work with the roofing installer.

3.19 ACCESSIBILITY:

- A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in double partitions and ceilings for the proper installation of their work. They shall cooperate with all others whose work is in the same space. Such spaces and clearances shall, however, be kept to the minimum size required.
- B. The Contractor shall locate and install all equipment so that it may be serviced, and maintained as recommended by the manufacturer. Allow ready access and removal of the entire unit and/or parts such as valves, filters, fan belts, motors, prime shafts, controls, coils, etc.
- C. Whether shown on the Plans or not, the Contractor shall provide in the Bid access panels for each concealed shut-off valve, motorized control damper, manual air damper or other device requiring service as shown on Engineer's Plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work. Change orders for access panels will not be accepted.

3.20 SCAFFOLDING, RIGGING AND HOISTING:

- A. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery onto the premises of any equipment and apparatus furnished. All such temporary appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

3.21 CONCRETE WORK:

- A. The Contractor shall be responsible for the provisions of all concrete work required for the installation of any of their systems or equipment. The Contractor may, at their option, arrange with the others to provide

the work. This option, however, will not relieve the Contractor of their responsibilities relative to dimensions, quality of workmanship, locations, etc.

- B. In the absence of other concrete Specifications, all concrete related to Mechanical work shall be 3500 psi minimum compression strength at 28 days curing, slump: 4" $\pm$ 1", air entrainment 4.5% water to cement ratio 0.5 and shall conform to the standards of the American Concrete Institute Publication AC1-318. Heavy equipment shall not be installed on pads for at least seven (7) days after pour. Insert 6-inch steel dowel rods into new and existing floors to anchor pads.
- C. All concrete pads shall be complete with all pipe sleeves, anchor bolts, reinforcing steel, concrete, etc. as required. Pads larger than 18" in width shall be reinforced with ½" deformed round bars on 6" centers both ways. Bars shall be approximately 2" above the bottom of the pad. All parts of pads and foundations shall be properly rodded or vibrated. If exposed parts of the pads and foundations are rough or show honeycomb after removing forms, all surfaces shall be rubbed to a smooth surface. Chamfer all vertical edges ¾" and tool horizontal edges with ¾" radius.
- D. In general, unless otherwise noted, concrete pads for equipment and piping penetrations shall be a minimum of 4" thick, extend six (6) inches beyond the equipment's base dimensions. Where necessary, show work on plans, extend pads 30 inches beyond base or overall dimensions to allow walking and servicing space.

3.22 RESTORATION OF NEW OR EXISTING LANDSCAPING, PAVING, SURFACES, ETC.:

- A. The Contractor shall at their expense restore to their original conditions all paving, curbing, surfaces, drainage ditches, structures, fences, landscaping, existing or new building surfaces and appurtenances, and any other items damaged or removed by their operations. Replacement and repairs shall be in accordance with good construction practice; by qualified tradesman, and shall match materials employed in the original construction of the item and shall be to the satisfaction of the Owner and/or Engineer.

3.23 MAINTENANCE OF EXISTING UTILITIES AND LINES:

- A. The locations of all piping, conduits, cables, utilities and manholes existing, or otherwise, that comes within the contract construction site, shall be subject to continuous uninterrupted service with no other exception than the Owner of the utilities permission to interrupt same temporarily. Provide a seven (7) day written notice to Engineer, Architect and Owner prior to interrupting any utility service or line.
- B. Known utilities and lines as available to the Engineer are shown on the Plans. However, it is additionally required that, prior to any excavation being performed, each Contractor ascertain and mark all utilities or lines that would be endangered by the excavation. Hand dig if required to locate. Contractor shall bear costs of repairing damaged utilities.
- C. If utilities or lines occur in the earth within the construction site, the Contractor shall probe and locate the lines prior to machine excavation in the respective area. Hand dig if required to locate.
- D. Cutting into existing utilities and services shall be performed in coordination with and as designated by the Owner of the utility. The Contractor shall work continuously to restore service(s) upon deliberate or accidental interruption, providing premium time and materials as needed without extra claim to the Owner.
- E. The Contractor shall repair to the satisfaction of the Owner and Engineer, any surfaces or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.
- F. Machine excavation shall not be permitted with ten feet of gas lines, fuel lines, electrical lines or lines carrying combustible and/or explosive materials. Hand excavate only in accord with utility company, agency or other applicable laws, standards or regulations.

- G. Protect all new or existing lines from damage by traffic, etc. during construction. Repairs or replacement of such damage shall be at the sole expense of the party responsible.
- H. Protect existing trees, indicated to remain with fencing or other approved method. Hold all new subsurface lines outside the drip line of trees, offsetting as necessary to protect root structures. Refer to planting or landscaping plans, or in their absence, consult with the Architect.

3.24 CLEANING:

- A. The Contractor shall, at all times, keep the area of their work presentable to the public and clear from rubbish and debris caused by their operations; and at the completion of the work, they shall remove all rubbish, debris, all of their tools, equipment, temporary work and surplus materials from and about the premises, and shall leave the area clean and ready for use. If the Contractor does not attend to such cleaning upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the Contractor. The Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of their rubbish or debris.
- B. After completion of all work and before final acceptance of the work, the Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of piping, equipment, fixtures and all other associated or adjacent fabrication.
- C. Piping shall be kept clean at all times. Piping stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic. Do not install the piping or insulation if the building is not "dried-in". If this is required, the entire lengths of duct shall be covered in plastic to protect. The Owner/Engineer may periodically inspect that these procedures are followed.

3.25 NOISE, VIBRATION OR OSCILLATION:

- A. All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Engineer. In case of moving machinery, sound or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner by the Contractor at their expense.
- B. The Contractor shall provide supports for all equipment they furnish. Supports shall be liberally sized and adequate to carry the load of the equipment and the loads of attached equipment, piping, etc. All equipment shall be securely fastened to the structure either directly or indirectly through supporting members by means of bolts or equally effective means. If strength of supporting structural members is questionable, contact Engineer.

3.26 EQUIPMENT/CONTROLS STARTUP & VERIFICATION:

- A. The Contractor and their Subcontractors shall include in the bid to provide equipment and startup and verification for ALL Systems specified for this project.
- B. Specific line-items shall be included on the schedule of values by each Trade for "equipment and startup".
- C. Specific startup/verification specifications are included throughout the Project Specifications. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians, not third party contractors, and shall complete and submit start-up reports/checklists. The Contractor shall have appropriate trades on site to correct all deficiencies noted by the factory representative. For each deficiency noted, documentation of corrective action (including date and time) shall be submitted to the Engineer and Owner. Where factory start-up is not specified for a particular piece of equipment or system, the Contractor shall be responsible to perform start-up. All information shall be completed by the Contractor and submitted to the Owner/Engineer prior to acceptance of the equipment.

- D. The manufacturer's recommended startup procedures and checklists will be acceptable for use in the project. All startup/verification process shall be thoroughly documented by the Contractor and shall include the time and date when performed.

3.27 INSPECTION, APPROVALS AND TESTS:

- A. Before requesting a final review of the installation from the Architect and/or Engineer, each Contractor shall thoroughly inspect their installations to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineer for unnecessary and undue work on their part.
- B. The Contractor shall provide as a part of this Contract any required Agency inspection, licensed and qualified to provide such services. All costs incidental to the provisions of inspections shall be borne by the Contractor.
- C. The Contractor shall advise each Inspecting Agency in writing, with an informational copy of the correspondence to the Architect and/or Engineer, when they anticipate commencing the work. Inspections shall be scheduled for rough-in as well as finished work. The rough-in inspections shall be divided into as many inspections as may be necessary to cover all rough-in without fail. Failure of the Inspecting Agency to inspect the work in a timely manner and submit the related reports may result in the Contractor having to expose concealed work not so inspected. Such exposure will be at the expense of the responsible Contractor.
- D. Approval by an Agency Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these Plans and Specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.
- E. Before final acceptance, the Contractor shall furnish the original and three (3) copies of the certificates of final approval by the Agency Inspector to the Engineer with one copy of each to the appropriate government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.

3.28 ABOVE-CEILING AND FINAL PUNCH LISTS:

- A. The Contractor shall review each area and prepare and complete their own punch list for each of the subcontractors as required for the Project Schedule.
- B. Seven (7) days notice shall be given to the Engineer for review of above ceiling work that will be concealed by tile or other materials. Seven (7) days notice shall be given to the Engineer for review of below ceiling work and final inspection.
- C. When all work from the Contractor's punch list is complete at each of the major Project Stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing seven (7) days prior to the proposed date. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review. The Contractor's representative may be requested at the inspections.
- D. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due net 10 days from date of each additional visit) at a rate of \$125.00 per hour plus travel expense for extra trips required to complete either of the above ceiling, below ceiling or final punch lists.

3.29 OPERATING INSTRUCTIONS:

- A. Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating the systems and equipment for a period of one (1) day of eight (8) hours. During this period, instruct the Owner or their representatives fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least seven (7) days written notice to the Owner, Architect and Engineer in advance of this training period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representatives that were present.
- B. Each Contractor shall furnish three complete bound sets for approval to the Engineer instructions for operating and maintaining all systems and equipment included in this contract. All instructions shall be submitted in draft form, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions. Refer to Specification Section SHOP DRAWINGS for additional detail.
- C. Each Contractor, in the above mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this contract and a detailed, easy to read parts list and the name and address of the nearest source of supply.

3.30 RECORD DRAWINGS:

- A. The Contractor shall ensure that any deviations from the Design are as they occur recorded in red, erasable pencil on record drawings kept at the jobsite. The Engineer shall review the record documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Pay particular attention to the location of water lines, shut-off valves, and other appurtenances important to the maintenance and operation of Fire Protection Systems. Also, pay particular attention to Deviations in all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose and deliver to the Engineer upon completion of the work.

END OF SECTION.

DIVISION 21 – FIRE SUPPRESSION

SECTION 210501 - SCOPE OF THE FIRE SUPPRESSION WORK

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR FIRE SUPPRESSION and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 SCOPE

- A. The Fire Suppression work for this Contract shall include all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, place in service and deliver to the Owner the complete mechanical systems in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include, but is not necessarily limited to the following paragraphs.
- B. Installation of all equipment per the manufacturer's instruction, whether specifically detailed or not.
- C. Thorough instruction of the Owner's maintenance personnel in the operation and maintenance of all mechanical equipment.
- D. Thorough coordination of the installation of all piping, equipment and any other material with other trades to ensure no conflict in installation.
- E. Approved supervision of the scope.
- F. Procurement of all required inspections, including fees for all inspection services and submission of final certificates of inspection to the Engineers.
- G. Start-up, verification and documentation as specified.
- H. Record drawings, final inspection certificates, test results, O & M documentation, warranty certification, and other specified closeout documentation.
- I. Required schedule of values breakdown.
- J. Pipe and equipment identifications.
- K. Preinstallation meetings and equipment mockups.
- L. 100% automatic sprinkler systems.
- M. Drainage systems.
- N. All required pressure testing, flushing, purging, pressure and flow testing requirements.
- O. Final coordination and connection of all equipment furnished.
- P. All required controls, including self checkout.

END OF SECTION.

DIVISION 21 – FIRE SUPPRESSION

SECTION 210502 – SHOP DRAWINGS, MAINTENANCE MANUALS AND PARTS LISTS

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR FIRE SUPPRESSION and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 SCOPE

- A. The Contractor shall prepare and submit to the Engineer, through the Prime Contractor and the Architect within thirty (30) days after the date of the Contract, required copies of all shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc. on all items of equipment specified hereinafter. Refer to Division 1 requirements for shop drawing submittal requirements.
- B. The Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for adaptability of the item to the project; compliance with applicable codes, rules, regulations and information that pertains to fabrication and installation; dimensions, weight and quantities; electrical characteristics; and coordination of the work with all other trades involved in this project.

PART 2 – PRODUCTS

- 2.1 Shop Drawings, descriptive literature, technical data and required schedules shall be submitted on the following:

Test Reports
Fire Protection Sprinkler System (2.2.A, 2.2.C)
Firestopping (2.2.C)
Controls & Components (2.2.B)
Valves

(Refer to the corresponding Special Notes.)

2.2 SPECIAL NOTES:

- A. For all items above, upon substantial completion of the project, the Contractor shall deliver to the Engineer (in addition to the required Shop Drawings) three (3) complete copies of operation and maintenance instructions and parts lists for each item above. Where available, documents shall include at least:
 - 1. Detailed operating instructions
 - 2. Detailed maintenance instructions including preventive maintenance schedules.
 - 3. Addresses and phone numbers indicating where parts may be purchased.
 - 4. Expanded parts drawings, parts lists, service manuals, schematics, wiring diagrams.
 - 5. Start-up reports, service records and test reports.
- B. Shop drawings for the Fire Suppression Systems shall include detailed, scaled plans and schematic diagrams indicating the function and operation of the system.
- C. Shop drawings for the Building Fire Protection System shall be prepared and stamped by a Certified Contractor and shall meet the criteria of the authority having jurisdiction and submitted to the Engineer. After the Engineer's review, they shall be submitted by the Contractor to the proper state authorities along

with the required agency review fee. Refer to Specification Section – FIRE PROTECTION for additional requirements.

- D. The Contractor shall submit project specific UL listed firestopping installation drawings to the authority having jurisdiction where required for their approval as required.
- 2.3 The Contractor shall prepare and submit to the Engineer, shop drawings including design calculations, detailed catalog cutsheets and layout drawings indicating the proposed automatic sprinkler system. All layouts and drawings shall be closely coordinated by the Contractor with the work of ALL other trades. The shop drawings shall indicate the following items:
- A. Name and address of Owner, Architect and Engineer.
 - B. Sprinkler heads including temperature rating.
 - C. Fire department connection.
 - D. Detector check valves.
 - E. Wet pipe alarm valves and wet system specialties.
 - F. Flanged gate and check valves.
 - G. Pipe hangers.
 - H. Supervised O.S & Y valve.
 - I. Fire valve cabinets.
 - J. The pressure sensing switch.
 - K. The post indicator supervisory switch (coordinated with the Fire Alarm Contractor).
 - L. The main gate valve supervisory switch (coordinated with the Fire Alarm Contractor).
 - M. The flow switch (coordinated with the Fire Alarm Contractor).
- 2.4 On a set of drawings to the same scale as the drawings accompanying these specifications, indicate:
- A. Each head location coordinated with lights, diffusers and other ceiling mounted device.
 - B. Location of all risers, mains, runout lines, etc.
 - C. Size of all risers, mains, runout lines, etc.
 - D. Location and type of pipe hangers.
 - E. All other information required by the Authority Having Jurisdiction providing approval.
- 2.5 The Contractor shall submit these shop drawings to the Engineer through the General Contractor and Architect for their review and approval. The Contractor shall submit the reviewed drawings to the Authority Having Jurisdiction for their review and approval. The Contractor shall incorporate all review comments from the Engineer and the Authority Having Jurisdiction. No work shall be performed onsite until all review processes are complete and updated drawings are on the job site.

PART 3 – EXECUTION

- 3.1 Provide all shops in electronic/PDF format. The Engineer's comments will be returned in electronic format.
- 3.2 Each shop drawing and/or manufacturers descriptive literature shall have the proper notation indicated on it selecting equipment, accessories and features and shall be clearly referenced to the specifications, schedules, fixture numbers, etc., so that the Engineer may readily determine what the Contractor proposes to furnish. All data and information schedules indicated or specified shall be noted on each copy of each submittal.
- 3.3 Submittal data shall include specification data including metal gauges, finishes, accessories, etc. Also, the submittal data shall include certified performance data, wiring diagrams, dimensional data, and a spare parts list. Submittal data shall be reviewed by the Engineer before any equipment or materials is ordered or any work is begun in the area requiring the equipment.
- 3.4 All submittal data shall have the stamp of approval of the Contractor submitting the data as well as the Prime Contractor and the Architect to show that the drawings have been reviewed by the Contractor. Any

drawings submitted without these stamps of approval may not be considered and will be returned for proper resubmission.

- 3.5 The Contractor shall make any corrections or changes required by the Engineer and shall re-submit for final review as outlined above.
- 3.6 It shall be noted that review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the Contract Documents. In all cases, the Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located. The Contractor shall also coordinate piping side connections.
- 3.7 Prior to ordering any materials or rough-in of any kind, the Contractor shall be responsible for final coordination of all electrical requirements (i.e. voltage, phase, circuit breaker, wire sizing, etc.) with the Electrical Contractor. There will be no change in the Contract Amount for any discrepancies. A final coordination meeting shall be held with the Architect, Owner, Engineer, Prime Contractor, Mechanical Contractor, Electrical Contractor and their sub-contractors.
- 3.8 Equipment shall not be ordered and no final rough-in connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractor. It shall be the Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. The Contractor shall coordinate with all the other trades having any connections, roughing-in, etc. to the equipment.
- 3.9 If the Contractor fails to comply with the requirements set forth above, the Engineer shall have the option of selecting any or all items listed in the Specifications or on the Drawings; and the Contractor shall be required to furnish all materials in accordance with this list.
- 3.10 Colors for equipment in other than mechanical spaces shall be selected from the Manufacturer's standard and factory optional colors unless noted otherwise on the Plans. Color samples shall be furnished with the shop drawing submission for such equipment.
- 3.11 All submittals for equipment shall include all information specified and scheduled. This shall include water pressure drops, RPM, noise data, horsepower, voltage motor type, steel or aluminum construction, and all accessories clearly marked.
- 3.12 All items listed in the schedules shall be submitted for review in a tabular form similar to the equipment schedule. All items submitted shall be designated with the same identifying tag as specified on each sheet.
- 3.13 Any submittals received in an unorganized manner without options to be provided specifically noted and with incomplete data will be returned for resubmittal.

END OF SECTION.

DIVISION 21 – FIRE SUPPRESSION

SECTION 210515 - SLEEVING, CUTTING, PATCHING, REPAIRING AND FIRESTOPPING

1.1 GENERAL:

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR FIRE SUPPRESSION and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 SCOPE

- A. The Contractor shall be responsible for all openings, sleeves, trenches, etc., that may be required in floors, roofs, ceilings, walls, etc., and shall coordinate all such work with the General Contractor and all other trades. Coordinate with the General Contractor, any openings which they are to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the Contractor.
- B. The Contractor shall plan their work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for piping, ductwork, conduit, etc., to route through; however, when this is not coordinated, the Contractor shall then do all cutting and patching required for the installation of their work, or pay other trades for doing this work when so directed by the Engineer. Any damage caused to the building by this Contractor shall be corrected or rectified at their expense.
- C. The Contractor shall notify other trades in due time where they will require openings or chases in new concrete, masonry, etc. Set all concrete inserts and sleeves for their work. Failing to coordinate, Contractor shall cut openings for the work and patch same as required at their expense with qualified tradesman.
- D. The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements shall be promptly and properly corrected to the satisfaction of the Engineer.
- E. All work improperly performed or not performed as required in this section, shall be corrected by the General Contractor at the responsible Contractor's expense.

PART 2 – PRODUCTS

2.1 SLEEVES:

- A. Cast iron or Schedule 40 steel sleeves shall be installed through all walls where pipe enters the building below grade. Sleeves shall be flush with each face of the wall and shall be sufficiently larger than the entering pipe to permit thorough caulking between pipe and sleeve for water proofing. Horizontal sleeves passing through exterior walls or where there is a possibility of water leakage and damage shall be caulked watertight. Utilize "Link-Seal" at these locations.
- B. In all cases, sleeves shall be at least two pipe sizes larger than nominal pipe diameter plus insulation. Sleeves through walls and floors shall be cut off flush with inside surface unless otherwise indicated.
- C. Vertical sleeves in roofs shall be flashed and counterflashed with lead (4 lb.) or 16 oz. copper and welded or soldered to piping, lapped over sleeve and properly weather sealed. Where sleeves pass through roof construction, sleeves shall extend minimum of 12" above the roof.

2.2 FIRE STOPPING

- A. Firestopping materials include (but are not limited to) wraps, strips, caulks, moldable putties, restricting collars with steel hose clamps, damming materials, composite sheets, fire dam caulks, steel sleeves, etc.
- B. The following indicates the 3M penetration details for uninsulated pipe penetration of various wall and floor construction types (the list is not inclusive):
 - 1. One, two or three hour fire rated concrete floor - 3M #5300-MPC8.
 - 2. One, two or three hour fire rated solid or block concrete wall - 3M #5300-MPC16 or 3M #5300-MPC26.
 - 3. One hour fire rated gypsum wallboard - 3M #5300-MPC7.
 - 4. Two hour fire rated gypsum wallboard - 3M #5300-MPC7.
- C. The following indicates the 3M penetration details for insulated pipe penetrations of various wall and floor construction types (the list is not inclusive):
 - 1. One, two and three hour fire rated concrete floor - 3M #5300-IMP2.
 - 2. One, two and three hour concrete block wall - 3M #5300-IMP2.
 - 3. One hour fire rated gypsum wallboard - 3M #5300-IMP4.
 - 4. Two hour fire rated gypsum wallboard - 3M #IMP7.

PART 3 – EXECUTION

- 3.1 The Contractor shall plan their work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for piping, conduit, etc., to route through; however, when this is not coordinated, the Contractor shall then do all cutting and patching required for the installation of their work, or pay other trades for doing this work when so directed by the Engineer. Any damage caused to the building by this Contractor shall be corrected or rectified at their expense.
- 3.2 The Contractor shall notify other trades in due time where they will require openings or chases in new concrete, masonry, etc. Set all concrete inserts and sleeves for their work. Failing to coordinate, Contractor shall cut openings for the work and patch same as required at their expense with qualified tradesman.
- 3.3 The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements shall be promptly and properly corrected to the satisfaction of the Engineer.
- 3.4 CUTTING:
 - A. All openings in plaster, gypsum board or similar materials, shall be framed by means of plaster frames, casing beads, or angle members as required. The intent of this requirement is to provide smooth, even termination of wall, floor and ceiling finishes as well as to provide a fastening means for devices, etc.
 - B. The Contractor shall coordinate all openings in masonry walls with the General Contractor; and, unless otherwise indicated in the Contract Documents, shall provide lintels for all openings required for the mechanical work such as louvers, exhaust fans, etc. Prime paint all lintels. Lintels shall be sized as follows:
 - 1. New Openings under 48" in width: Provide one 3½"x3½"x3/8" steel angle for each 4" of masonry width. Lintel shall have 8" bearing on each end.
 - 2. New Openings over 48" in width: Consult with Structural Engineer.

- C. No cutting shall be performed at location that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Engineer.
- D. Pipe openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe-cut with a masonry saw.

3.2 PATCHING, REPAIRING AND FINISHING:

- A. Patching and repairing made necessary by work performed under this Division shall be included as a part of the work and shall be done by skilled workers of the trade. The work shall be performed in strict accordance with the provisions herein before specified to match adjacent surfaces and in a manner acceptable to the Engineer.
- B. Where portions of existing sites, lawns, shrubs, paving, etc. are disturbed for installation of work of this Division, such items shall be repaired and/or replaced back to original or better condition to the satisfaction of the Engineer.
- C. Piping and passing through floors, ceilings and walls in finished areas shall be fitted with chrome plated brass escutcheon trim pieces of sufficient outside diameter to amply cover the sleeved openings and an inside diameter to closely fit the pipe/duct around which it is installed.
- D. Flanged metal collars shall be provided around all pipes at all wall penetrations; both sides. Penetrations through any wall will require the installation of flanged collars. Openings shall not be any larger than 2" in any direction than the piping/duct passing through the wall. Openings larger than this requirement shall also be infilled to match adjacent construction. Fill void with insulation for sound reduction.

3.3 FIRESTOPPING:

- A. Provide shop drawings indicating penetration detail for each type of wall and floor construction. Shop drawings must be specific for each individual type of penetration (one hour fire rated gypsum wall board with insulated metal pipe penetration, etc.) Provide copies to the authority having jurisdiction if required.
- B. All pipes penetrating fire rated floors and walls shall be firestopped by this Contractor. All firestopping products and assemblies installed shall be UL listed.
- C. Where the installation of conduit, ducts, piping, etc. requires the penetration of fire or smoke rated walls, ceilings or floors, the space around such conduit, duct, pipe, etc., shall be tightly filled with an approved non-combustible fire insulating material and properly sealed to maintain the rating integrity of the wall, floor or ceilings affected.
- D. The manufacturer of the firestopping materials shall provide on site training for the installing Contractor. The training session shall demonstrate to the Contractor the proper installation techniques for all the firestopping materials.
- E. Firestopping materials include (but are not limited to) wraps, strips, caulks, moldable putties, restricting collars with steel hose clamps, damming materials, composite sheets, fire dam caulks, steel sleeves, etc.
- F. The following indicates the 3M penetration details for uninsulated pipe penetration of various wall and floor construction types (the list is not inclusive):
 - 1. One, two or three hour fire rated concrete floor - 3M #5300-MPC8.
 - 2. One, two or three hour fire rated solid or block concrete wall - 3M #5300-MPC16 or 3M #5300-MPC26.
 - 3. One hour fire rated gypsum wallboard - 3M #5300-MPC7.
 - 4. Two hour fire rated gypsum wallboard - 3M #5300-MPC7.
- G. Multiple pipes penetrating fire rated floors and walls may be firestopped as a group. Submit details for

specific applications if this method of firestopping is chosen.

END OF SECTION.

DIVISION 21 – FIRE SUPPRESSION

SECTION 210553 - IDENTIFICATIONS, TAGS, CHARTS, ETC.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR FIRE SUPPRESSION and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

PART 2 – PRODUCTS:

2.1 TAGS AND CHARTS

- A. Provide and install on each valve 1" in size or greater for all mechanical systems a 1.5" diameter circular bronze or baked phenolic tag fitted to each valve so that it cannot be removed. Each tag shall be embossed consecutively with sequential number identifiers. Number identifiers shall be determined by the Contractor sequentially.
- B. Provide typewritten valve charts indicating each valve identifier, the valves service, normal position and its location. Also furnish one electronic copy on CD in "*.xls" format. One (1) copy of this chart shall be mounted in suitable frame(s) with clear plastic covers in a conspicuous location in each of the major mechanical rooms. Repeat only main valves which are to be operated in conjunction with operations of more than single mechanical room.
- C. All emergency shutoff valves shall be identified with a permanent engraved tag hung from the valve with 1-inch high lettering. Emergency shutoff valves shall be identified.
- D. Label all control panels and disconnect switches with service and equipment served.

2.2 PIPING IDENTIFICATION:

- A. All piping and ductwork installed shall be identified according to the charts hereinafter specified. Provide stenciled markers and arrows indicating direction of flow on all piping and ductwork installed under this contract. Markers and arrows shall be painted on the piping and ductwork using machine cut stencils. All letters shall be sprayed using fast drying lacquer paint. All markers and arrows shall be properly oriented so that descriptive name may be easily read from the floor. Piping and ductwork shall be identified on twelve (12) foot centers. All piping and ductwork shall be minimally identified once above all room ceilings and where it passes thru walls or floors. At the Contractor's option, Setmark or equivalent manufactured marking system may be substituted for field marking.
- B. The following table describes the size of the color field and size of the identification letters which shall be used for pipes of different outside pipe diameters.

Outside Diameter	Label Length	Letter Size
3/4" – 1 1/4"	8"	1/2"

1 ½" – 2"	8"	¾"
2 ½" – 6"	12"	1 ¼"
8" – 10"	24"	2 ½"

- C. The following chart describes the pipe service and label identification which shall be used for various pipes.

<u>PIPE</u>	<u>ABBREVIATION</u>
Fire Protection	SPRINKLER

PART 3 - EXECUTION

3.1 EQUIPMENT IDENTIFICATION:

- A. Unless otherwise specified, all equipment shall be identified. The titles shall be short and concise and abbreviations may be used as long as the meaning is clear. In finished rooms and mechanical rooms, equipment shall be identified neatly and conspicuously with engraved black lamacoid plates (or equivalent) with 1" high white letters on the front of each piece of equipment.
- B. All equipment and associated starters/disconnects shall have the electrical panel number and circuit number identified on a lamacoid plate. Coordinate with the Electrical Contractor.

3.2 ACCESS THROUGH LAY-IN CEILINGS:

- A. Mark each lay-in ceiling panel which is nearest access to equipment, valves, dampers, filters, duct heaters, etc., with colored tape labels located on the ceiling grid.

END OF SECTION.

DIVISION 21 – FIRE SUPPRESSION

SECTION 211000 - FIRE PROTECTION SYSTEM

PART 1 - GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR FIRE SUPPRESSION and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- B. Each Contractor's attention is also directed to Specification Section SHOP DRAWINGS, MAINTENANCE, MANUALS AND PARTS LISTS FOR FIRE SUPPRESSION.

1.2 SCOPE

- A. No Contractor, other than those regularly engaged in the installation of approved and franchised automatic sprinkler systems will be considered or approved for the work under this Specification Section. The Contractor shall have not less than five (5) years experience in the fabrication and erection of fire protection systems as specified. The Contractor shall have completed five (5) installations similar and equivalent in scope to the systems specified.
- B. Before submitting bid, examine the Contract Documents, visit the site (if necessary) and become acquainted with all conditions that may, in any way whatsoever, affect the execution of this work. The Contractor shall take their own measurements and be responsible for exact size and location of all openings required for installation of this work. Figured dimensions where indicated are reasonably accurate and should govern in setting out work. Detailed method of installation is not indicated. Where variations exist between described work and approved practice, the Engineer shall be consulted for directive.
- C. It is the intent of the Plans and Specifications to provide a general layout only and locate major equipment, components, piping, etc. Variations in head locations, pipe routing, etc., shall be anticipated by the Contractor and shall be coordinated with all other trades and indicated on the drawings and descriptive literature called for hereinafter. It shall be the express responsibility of the Contractor to provide all required design, materials and equipment and perform all work required to install a complete and approved installation.
- D. All materials and methods shall be in accordance with applicable codes, regulations and/or ordinances and meet approval of local inspection authority and the State Fire Marshal. Also, all work shall comply with the latest editions of the National Board of Fire Underwriters, National Fire Protection Association, OSHA Regulations, the International Building Code, the Life Safety Code, International Mechanical Code and governing building codes. All materials and equipment installed as a part of this work shall be listed by the Underwriters Laboratories, Inc. as approved for fire protection installations.
- E. Where flow and pressure data are available, they are indicated on the project drawings. The Contractor shall independently verify all such information and notify the Engineer of any discrepancies discovered prior to beginning the work. Where no flow information is indicated on the project drawings, the Contractor shall obtain the data and indicate it on the shop drawing submittal. All flow information obtained shall be less than six (6) months old. Piping systems shall be hydraulically sized based on the most conservative flow information obtained. No adjustments in the contract amount will be allowed for failure of the Contractor to obtain adequate flow information.
- F. All work performed under this section shall be accomplished in close harmony with all other trades. All work not so coordinated shall be removed and reinstalled at the expense of the Contractor.

PART 2 – PRODUCTS:

- 2.1 FLOW INDICATOR SWITCHES: Furnish and install flow indicator switches as required by NFPA 13. All flow indicator switches shall be UL approved. Coordinate with Fire Alarm System supplier/installer.
- 2.2 TAMPER SWITCHES FOR WATER SHUT-OFF VALVES: Furnish and install tamper switches where required by NFPA 13. All tamper switches shall be UL approved. Coordinate with Fire Alarm System supplier/installer. All tamper switches located in fire protection pits shall be waterproof, capable of operating beneath water and be NFPA approved.
- 2.3 GATE VALVES: 2½" and over; listed and approved by UL and FM; marked SV-FM; 175# working pressure; 1 BBM; OS&Y; flanged; cast iron discs; bronze seat rings; four point wedging mechanism; equivalent to Mueller, Scott or Lunkenheimer. 2" and under; 150# working pressure; bronze; rising stem; screwed; bronze discs; bronze seat rings; two point wedging mechanism; equivalent to Jenkins, Scott or Lunkenheimer.
- 2.4 CHECK VALVES: 2½" and over; listed and approved by UL and FM; marked SV-FM; 175# working pressure; 1 BBM; flanged; equivalent to Mueller, Scott or Lunkenheimer. 2" and under; 150# working pressure; bronze; screwed; equivalent to Jenkins, Scott or Lunkenheimer.
- 2.5 INTERIOR PIPE & FITTINGS: Up to 2" Schedule 40 ASTM A-53 black steel; 125# cast iron screwed fittings. 2½" and larger. Schedule 40 black steel with flanged, welded or victaulic (or similar) type approved fittings.
- 2.6 SPRINKLER HEADS: Tyco, Gem, Grinnell, Star, Viking, Reliable: All sprinkler heads shall be fed in a reverse bend arrangement. Sprinkler head degree ratings shall be determined by the area serviced in accord with current Codes and Standard Practices. Types of sprinkler heads shall be as follows:
- A. Upright, Quick Response – Reliable (or equal) Model F1, Vertical Upright automatic sprinkler head.
 - B. Sidewall, Quick Response – Reliable (or equal) Model F1, horizontal sidewall automatic sprinkler head.
 - C. Concealed, Quick Response – Reliable (or equal) Model G4, Concealed automatic sprinkler head. Cover shall be white unless noted below:
 - a. Concealed sprinklers in elevator lobbies on floors 2, 3 and 4 shall be switched from the existing white covers to be provided with black covers.
 - b. Concealed sprinklers in specialty wood faux ceilings in Coworking Loung 402 shall be provided with cover plates matching Sherwin Williams SW9099 Saddle Up.
 - D. Window Sprinklers – Tyco WS (or equal), Pendent vertical window sprinklers.
 - E. At the Contractor's option, extended coverage sprinkler heads may be used where appropriate.
 - F. At the Contractor's option, code approved flexible sprinkler heads may be used where appropriate and in compliance with the installation requirements of these specifications.
 - G. When working in existing facilities, sprinkler heads style and color shall match existing.
- 2.7 CLAMPS AND ANCHORS: Furnish and install approved clamps, as required, at all (45 degree) 1/8 bends, (90 degree) ¼ bends and flange and spigot pieces to the straight pipe to insure permanent anchorage of all fire lines. Fittings, clamps, clamp rods, nuts, washers, and glands shall be factory zinc-coated.
- 2.8 HANGERS: All piping shall be adequately and permanently supported in an approved manner on approved hangers. Minimally support piping on 8 foot intervals for pipe 3" and smaller; 10 foot intervals for larger piping. Also support within 24" of changes in direction and end of runs.

- 2.9 SLEEVES AND ESCUTCHEON PLATES: Furnish and install sleeves for pipes where piping penetrates masonry walls; exterior wall sleeves to be watertight. Fire and smoke stop all penetrations through fire and smoke walls and coordinate with General Contractor for locations. Furnish and install cast brass chrome plated split ring type escutcheons where piping penetrates walls, ceilings and floors, whether in finished areas or not.
- 2.10 INSPECTION TEST CONNECTIONS & PRESSURE GAUGES: A 1" inspection test connection as required by the Building Code. Discharge shall run to open air. Control valve for test connection shall be installed not over 7' above the floor. A pressure gauge at the inspection. Test connection at each location indicated on the Plans. Pressure gauges shall be 2½" diameter and readable from the floor.
- 2.11 SIGNS: Appropriate code approved and required signs shall be installed on all control valves, drains, inspector's test, etc., indicating the function, installation, etc. Signs shall be neatly affixed with rust inhibitive screws, rivets or where hung from piping; with stainless steel No. 14 AWG wire.
- 2.12 SPRINKLER HEAD CABINET: Furnish and install a cabinet, clearly labeled, with four (4) sprinklers of each type complete with required wrenches. Label "Sprinkler Heads".

PART 3 – EXECUTION:

- 3.1 Furnish all material, labor, tools, equipment and supervision required for installation of a complete and new fire protection system as indicated on the project drawings and within these specifications. Include all necessary piping, sprinkler heads, test connections, valves, drains, etc.
- 3.2 The Contractor shall provide flushing and sterilization of all water lines in accordance with current Codes, Rules and Regulations and shall make connection to domestic water mains in accord with current rules and regulations of the State Department of Sanitary Engineering and Division of Water.
- 3.3 The Contractor shall obtain and pay for all necessary state, municipal, county, city and other permits and fees and pay all State taxes which are applicable.
- 3.4 All workmanship, equipment and material shall be guaranteed in writing against defects from any cause, other than misuse, for a period of one year from substantial completion.
- 3.5 Upon completion, the Contractor shall submit to the Engineer, a properly completed "Sprinkler Contractor's Certificate Covering Materials and Tests" form.
- 3.6 Upon completion of this work all debris, material, and equipment shall be removed from the building and premises; all piping shall be cleaned ready for finish painting. Do not remove rust inhibitive primer specified hereinafter.
- 3.7 Do not route sprinkler piping (including drops) directly above any light fixtures. Do not route sprinkler piping near ceiling; hold tight to structure. Where large volumes occur above ceiling route pipe at least 36" above ceiling. The Sprinkler Contractor shall coordinate during design of sprinkler systems to insure these requirements are met.
- 3.8 Where sprinkler heads are installed in a tile ceiling, they shall be installed in the middle of the tiles, at half or quarter points along the length of the tiles.
- 3.9 SYSTEM DRAINAGE:
- A. The entire System except that part which is below grade and will not freeze shall be installed so as to allow 100% drainage.

- B. All sprinkler branch piping shall be installed so as to drain back to the main riser.
- C. Approved 2" drawoff piping shall be provided on sprinkler risers with discharge piping running to nearest floor drain or open air.
- D. Where sprinkler piping is trapped, an approved auxiliary draw-off shall be provided and neatly installed.
- E. All draw-offs shall have a metal tag labeled "Sprinkler Drain".

3.10 INSPECTIONS AND TESTS:

- A. Furnish all labor, equipment and conduct all required tests in the presence of the Owner and Engineer or designated representative if requested. Coordinate with Owner and Engineer prior to testing.
- B. All interior and exterior piping and devices comprising the fire protection system shall be tested under hydrostatic pressure of not less than 200 PSI and maintained for not less than two (2) hours. Any leaks or cracks developing as a result of these tests shall be repaired to the satisfaction of the Owner.
- C. Upon completion of their work, the Contractor shall submit a written and signed certificate to the Engineer indicating that they performed the above prescribed tests and rectified all malfunctions arising therefrom.

END OF SECTION.

SECTION 220170.00 - OPERATION AND MAINTENANCE OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Closeout Submittal
 - 1. Operation and Maintenance Manuals: Include operation and maintenance manuals for all fixtures, equipment, and systems specified under Division 22.
- A. Shop Drawings
 - 1. As-Built Drawings: For recording installed conditions that deviate from design documents.

1.2 OPERATING AND MAINTENANCE MANUAL

- A. The contents of operating and maintenance manual shall include the following:
 - 1. Project Information Cover: Title of Project; Name and address of Owner, Design Professionals, Contractor of Record and Subcontractor; System name and specification references.
 - 2. Index: Contents of the manual.
 - 3. Warranty Statements: Furnish a warranty statement for each system, reiterating the terms of warranty identified within the Contract Documents, and identifying how the Owner is to obtain warranty service. Clearly identify which products are covered by Manufacturer warranties beyond the Contractor required minimum warranty period. The term of manufacturer warranty shall also be identified (e.g., 1-year parts and labor). Identify the date that the warranty for the system starts. This date shall be the date listed on the Certificate of Substantial Completion (if one was issued to the contractor specifically for the system) or the date listed on the Notice of Final Completion. Supply standard out-of-warranty service rates and service contact information.
 - 4. Bill of Materials: List of products supplied, and serial numbers of each product.
 - 5. Product Datasheets and Shop Drawings: Manufacturer datasheets and shop drawings for each product and system supplied.
 - 6. Manufacturer Owner / User Manuals: Manufacturer's Owner's or User's manual for each product, and Manufacturer's Installation instructions and other documentation supplied with the product.
 - 7. Spare and Replacement Parts Schedule:
 - a. Complete spare parts schedule for components of equipment furnished, which are not factory generic information, but accurate for the equipment provided.
 - 8. Maintenance Procedures: Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; testing, aligning and adjusting instructions.
 - 9. Function and Operating Descriptions: Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

10. Operating Procedures: Manufacturer's printed operating procedures including start-up, break-in, normal operating instructions, regulation, control, stopping, shutdown, and emergency instructions.
11. Test Reports and Checklists: Test reports, checklists, and other forms generated and completed for the Project.
12. Training Information: Copy of training outlines/agendas, training session handouts, training sign-in sheets, and signed delivery receipt for each training session recording; Separate USB drive, labeled, for audio/video-recorded instructions to Owner, for operations and maintenance for each system.
13. As-Built Drawings.

1.3 AS-BUILT DRAWINGS

- A. Obtain two complete sets of plumbing prints and use them to provide progress record drawings which are separate, clean, prints reserved for the purpose of showing a complete picture of the work as actually installed (including routing of conduit and cables). These drawings also serve as work progress report sheets. Make notations, neat and legible thereon daily as work proceeds. Make these drawings available for inspection at all times and keep them at the job at a location designated by the Owner's Representative.
- B. Maintain the clean, undamaged set of prints of drawings as well as a set of submittal drawings and coordination drawings. Mark the sets to show the actual installation where the installation varies from the Documents as originally shown. Include locations of underground and concealed items if placed other than shown on the Documents. Where shop drawings are used, record a cross-reference at the corresponding location on the Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
- C. Show changes in: size, type, capacity, etc., of material, device or piece of equipment, location of device or piece of equipment; location of source of building service systems; routing of piping, and/or other building services. Record location of concealed equipment, plumbing service work, piping, and other work by indication of measured dimensions to each line from readily identifiable and accessible walls, column lines or corners of building. Indicate approved substitutions, modifications, and actual equipment and materials installed.
- D. Affix near the titleblock on each drawing the Contractor's Company Name(s), signature of Contractor's Representative(s) and current date.
- E. For plumbing work installed below slabs, pavements, grade, etc., record location of nearby concealed water piping, sewers, wastes, vents, ducts, conduit and other piping, etc. by indication of measured dimensions to each line from readily identifiable and accessible walls or corners of building and from adjacent electrical work. Show invert elevation of underground plumbing work relative to work installed by other trades.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTRUCTION OF THE OWNER'S PERSONNEL

- A. Provide instruction in the proper operation and maintenance of equipment that requires routine servicing. Include the following:
 - 1. Review of operation and maintenance manuals.
 - 2. Required tools.
 - 3. Lubricants.
 - 4. Spare parts.
 - 5. Cleaning.
 - 6. Hazards.
 - 7. Warranties and maintenance agreements.
- B. Demonstrate equipment and systems operation including the following:
 - 1. Start-up.
 - 2. Shut-down.
 - 3. Emergency conditions.
 - 4. Safety procedures.
 - 5. Setpoint and schedule adjustments.
 - 6. Economy and efficiency adjustments.

End of Section 220170.00

SECTION 220501.00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Shop Drawings
 - 1. Coordination Drawings: This contractor shall provide necessary coordination drawings required to make sure all disciplines are coordinated and fit into specified spaces (i.e. ceilings, chases, and all others). It is the work of the contractor to prepare complete coordination drawings indicating exact location, clearances and penetrations of all items of all trades.

1.2 GENERAL DIRECTION

- A. Submittal of a bid indicates that the contractor has examined the drawings, specifications, and had an opportunity to visit the site to be able to provide a comprehensive complete bid.
- B. The intent of these specifications and the accompanying drawings is to provide complete and workable systems as shown, specified and required by applicable codes. Interpret these specifications in conjunction with the drawings and provide all work described. If work is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both. Should there be a conflict between the specifications and drawings, provide the greater quantity or better quality. Immediately notify owner's representative and design professional of such conflicts.
- C. The drawings that accompany these specifications are diagrammatic and although size and location of equipment is drawn to scale wherever possible make use of submittal data and verify all dimensions on site. Drawings may not reflect every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts. Follow the drawings as closely as is practical and install additional bends, offsets and elbows where required by site conditions and codes at no additional cost. Install all new work in such manner as to conform to the structure, avoid obstructions, provide required service clearances and preserve headroom. Do not scale from drawings, all measurements should be taken in the field.
- D. Coordinate all work with all other contractors and installers in addition to existing building obstructions and install accordingly. Comply with requirements of architectural drawings including but not limited to mounting height and locations. Fully research peculiarities and limitations of space available for installation of work with materials being provided. Work around material lead times to not extend project schedule.
- E. Complete work, or part(s) thereof, at times as may be designated by the Owner's Representative, so that it can be used for temporary or permanent use. Do not construe such use of the system as an acceptance of it by Owner.

- F. During mobilization or construction, if an abnormal condition is uncovered either with existing conditions, equipment loads, submittal data, etc. bring these to the attention of the Design Professional for review.
- G. Owner's Representative or Design Professional may relocate devices prior to installation within a 20-foot limit at no additional charge.
- H. All piping shall be run as straight as possible and symmetrical with architectural items. Piping shall be concealed in pipe shafts, pipe spaces and furring wherever possible. Piping installed before coordination with the other trades will be done at the contractor's risk.

1.3 GENERAL STANDARDS

- A. Provide materials, installation methods, workmanship, testing, etc., in strict accordance with the latest edition of applicable standards and adopted codes, including (but not limited to) the following.
 - 1. State and/or local Building Codes.
 - 2. State and/or local Plumbing Codes.
 - 3. American Society of Test Materials (ASTM)
 - 4. Underwriters Laboratories (UL)
 - 5. American Gas Association (AGA)
 - 6. National Sanitation Foundation (NSF)
 - 7. American National Standards Institute (ANSI)
 - 8. National Electric Code (NEC)
 - 9. Building Code Seismic Relative Displacement Requirements

1.4 PERMITS AND REGULATIONS

- A. Obtain and pay for permits, fees, certificates of inspection and approval, etc. required for this branch of the work. Furnish Owner with certificates of final inspection and approval prior to final acceptance of this branch of the work.
- B. Laws and regulations which bear upon or affect the various branches of this work shall be complied with by this contractor and are hereby made a part of this contract.

1.5 DEFINITIONS

- A. Furnish - Procure, supply and deliver to project site, ready for installation, install and warrant (unless indicated otherwise on documents). Include warranty expenses.
- B. Install - To supply labor, tools and incidental materials necessary to handle, store, mount, terminate, program, configure and adjust a product in order render the respective product and system fully operational and usable to the Owner for the intended purpose
- C. Provide - Furnish and Install. Similar Terms: "include", "shall", "equip with", "consisting of".
- D. Equal or Equivalent - Determination of equivalency to be made by design professional for all products not listed as basis-of-design.

- E. Substantial Completion - Where frontend documentation does not define, products and systems must be fully installed as designed, tested, adjusted, labeled, and functionally demonstrated to owner.

1.6 REQUESTS FOR INFORMATION

- A. Submit all questions, requests for information (RFIs) and similar queries through the formally-established RFI process for the project that has been accepted by the Owner's Representative, Design Professionals, Prime Contractor and subcontractors. Submit as a PDF file. Do not submit as text in an email.

1.7 AVAILABILITY OF ELECTRONIC DRAWINGS

- A. If expressly permitted by the Owner and the terms of the Contract, editable electronic drawings may be made available for the creation of shop and as-built drawings upon request. Drawings will be made available at the discretion of the Engineer.

1.8 QUALITY ASSURANCE

- A. Contractor shall have a minimum five (5) years experience in the installation of systems similar to the systems specified. Contractor, if requested, shall demonstrate his ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of the contractor's inability to perform.

1.9 WARRANTY / GUARANTEE

- A. Provide a warranty/guarantee in written form as part of O&M manual stating that all work, materials, equipment and parts are warranted to be free of defect for a minimum period of one year from the date of Substantial Completion. Warranty period and requirements may be expanded in drawings or subsequent specification sections. Repair or replace (owner's option) any defects or failures at no cost to the owner within the warranty period. Issues arising within warranty period must be attended to in a timely manner and in no case exceed four (4) working days. State this in writing as part of O&M manual. Replace defective items to the satisfaction of the Owner's Representative and the Design Professional.

1.10 COMMISSIONING

- A. An independent third-party Commissioning Agent will document completion of the Plumbing Systems. The Construction Manager and Division 22 Contractor(s) are members of the Commissioning Team and will facilitate completion of the Commissioning process. Refer to Section 019113 Building Systems Commissioning for the project Commissioning requirements and roles and responsibilities of each member of the Commissioning Team.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide materials that are new, full weight, and of the best quality. Obtain equipment, components and materials from single manufacturer for products of the same kind or category. Provide materials that are listed and labeled and marked for intended location and application.
- B. Provide basis of design products or listed products equivalent in quality, performance, aesthetics, and product support (factory and local) to that specified as basis of design. Products not basis of design are subject to review by the Design Professional and possible rejection. Listing of a product manufacturer by name alone as an equivalent manufacturer shall not equate all products offered by that manufacturer to the basis of design.
- C. Bear all costs incurred from deviation from basis-of-design materials, methods, labor, services, etc. Use of materials, methods, labor, services, etc. that deviate from the basis-of-design will be considered a statement that capacities, requirements, clearances, arrangements, performance, etc. have been checked, verified, found satisfactory, and align with intent of specified work and applicable codes and regulations.
- D. Should deviation from basis of design equipment impact other contractors scope of work it shall be the responsibility of this contractor to coordinate with and cover these costs in addition to their own. This specifically includes electrical deviations from basis of design.
- E. All manufacturer or contractor provided electrical disconnect switches shall comply with current National Electric Code requirements and rated to meet or exceed the overcurrent device serving the equipment.
- F. Products shall not contain asbestos, lead, mercury, or mercury compounds and shall be suitable for piping service fluids, materials, working pressures, and working temperatures. Potable-water piping and components shall be deemed lead-free and comply with NSF 61 and NSF 14.

PART 3 - EXECUTION

3.1 GENERAL DIRECTION

- A. Unless specifically indicated, provide all specified and drawn work as required to render all equipment and systems fully operational, including all ancillary, accessory, and support work. Install equipment and materials in strict accordance with manufacturer's written instructions.
- B. In cases where products / materials are furnished by Owner or others, provide the following services: receive, transport and securely store materials on site; remove materials and components from packaging; assemble all materials and components per factory instructions; install, wire and connect materials and components as recommended by manufacturer for a fully operational installation.
- C. Remove and replace items that impede new work installation including but not limited to fencing, doors, gypsum, lift-out panels, and structures to provide pathway for moving equipment into place.

- D. Examine surfaces to receive products for suitable mounting conditions and verify compliance with installation tolerances and other conditions affecting performance of the work. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Equipment shall be installed in accordance with manufactures installation recommendations. Provide and maintain service, maintenance and operating clearances as required by the manufacturer.

3.2 SUPERVISION AND WORKMANSHIP

- A. Workmanship throughout shall conform to the standards of best practice and all labor employed must be competent and qualified to do all the work required.
- B. Contractor shall furnish the services of an experienced superintendent to be in constant charge of the work at all times. The superintendent's qualifications are subject to the review and acceptance by the Owner's Representative. Utilize the same plumbing superintendent throughout the duration of the project.
- C. Provisions shall be made for owner's representative or design professional to make rough-in and open ceiling inspections prior to covering up work.
- D. Coordinate sizes and locations of concrete bases with architectural and structural elements. Concrete base shall be provided with all equipment provided.
- E. Protect all piping, fixtures, and equipment exposed to physical damage.
- F. Handling Flammable Liquids: Remove and dispose of liquids from existing gas piping according to requirements of authorities having jurisdiction.

3.3 CHANGE OF WORK

- A. In the event of revised scope or work formally issued through Change of Work order, contractor shall provide an itemized breakdown of pricing and receive approval prior to commencing work.

3.4 ARCHITECTURAL COORDINATION ITEMS

- A. Cutting and Patching:
 - 1. Cut and drill all openings in roofs, walls, and floors required for the installation. Neatly patch all openings cut. Hold cutting and patching to a minimum by arranging with other contractors for all sleeves and openings before construction is started. When drilling/cutting concrete slabs, utilize ground penetrating radar (GPR) and/or X-ray scanning equipment to verify the location is free from obstructions, including but not limited to: structural rebar/strands/tendons, electrical conduit/wiring, and/or piping/ductwork.
- B. Fire Caulking:
 - 1. Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch.

2. Provide products equivalent to the following:
 - a. For Floor Openings: 3M; Fire Barrier Sealant CP 25WB+
 - b. For Wall Openings: 3M; Fire Barrier Sealant CP 25WB+
 - c. Mineral Felt: Rockwool; Firepro Firestop Compound
 - d. For Insulated Pipes: 3M; Fire Sealant System CAJ5211
 - e. For Fill Areas: 3M; Fire Barrier Packing Material PM 4
3. For larger openings where pipes penetrate fire rated enclosures that cannot be sealed with products described above, utilize approved UL products equal to 3M FireDam Spray 200.

C. Access Panels:

1. Provide all access panels required for proper servicing of equipment. Provide fire rated access panels at fire rated assembly penetrations rated at or above the fire rating of the assembly. Provide frame as required for finish. Coordinate installation with General Contractor as they may elect to install access panel. Exact location(s) must be approved by the Architect. Minimum size to be 12" x 12", units to be 16-gauge steel, primed for paint, and locking device shall be screwdriver cam locks.
2. For equipment above gypsum board or "hard ceilings", provide equipment access panels sized to permit complete holistic removal of the unit in its entirety. Access panel shall also be sized to accommodate removal of the largest piece of equipment in the case where such access panel is used as a removal pathway for multiple pieces of equipment.

3.5 PROTECTION OF SURFACES

- A. Make every effort to protect roofs, walls and floors from dust, debris, water, sewage, foot traffic, equipment, carts, lifts, etc. prior to and during construction phase(s).
- B. Make roof penetrations and install roof flashing in accordance with roofing manufacturer's recommendations. Obtain written certification from roofing manufacturer that work has been performed properly and that roof warranty is intact.

3.6 UTILITY VERIFICATION REQUIREMENTS

- A. Field verify locations of underground and aboveground utilities, or those otherwise obscured from view, in the vicinity of work prior to commencing work. Utilize "811" call before you dig and hire locating service to identify, locate and mark remaining utilities and private lines.
- B. Camera scope and dye testing existing piping, ductwork and pathways to confirm existing conditions and use including, but not limited to, voltage, natural gas pressure, sanitary, storm, chilled water, steam, etc.)
- C. Obtain on-site approval from local utility prior to connecting to existing services.
- D. Failure to perform the above shall result in contractor proceeding at their risk and accepting full responsibility for incorrect connections.

3.7 DELIVERY, STORAGE, HANDLING, AND PROTECTION

- A. Receive, inspect, store and protect all materials required for new work. Do not accept or install any product damaged in any way.
- B. Comply with all manufacturer guidelines and requirements for movement, storage, and protection of new work. All new work must be stored in a clean, dry place protected from weather and construction traffic. Maintain acceptable temperature and humidity per manufacturer recommendations. When stored inside or during transport through building, do not exceed structural capacity of the floor.
- C. Coordinate and account for sizes of all new work included shipping materials with available openings. Account for rigging of all new work as required and as intended by manufacturer.
- D. Do not install work until work area is sufficiently weathertight, all wet work in area is complete and all work above is complete.
- E. Prior to installation, all products shall have the ability to be returned to the supplier or manufacturer after purchase and charged a reasonable restocking fee equal to a small portion of the cost.
- F. Protect all new work through construction from damage. Take safeguards necessary to protect from damage. Items damaged during construction will not be accepted and shall be replaced with new.
- G. Remove and replace all materials that have been installed improperly, physically damaged, moisture or water damaged, or mold damaged.
- H. Fully remove all packaging materials inside and out prior to startup.
- I. Retain all shipping protective covers and protective coatings during storage.
- J. Fixtures and equipment being shipped and/or stored shall be covered with plastic sheeting and enclosed in a cardboard or wood crate.
- K. Protect drains throughout all phases of construction to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- L. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.8 EXCAVATING AND BACKFILLING

- A. Perform all excavation and backfilling required for admittance of work. Execute work safely providing slope sides, shoring and bracing as required for stability.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations. Properly restore streets, sidewalks, concrete and blacktop surfaces that were broken during the excavation process.
- C. Remove materials of every nature encountered in obtaining indicated lines and grades as shown on drawings. Excess excavated earth materials shall be removed from the site.

- D. Where soft or poor load-bearing quality soils are found at the bottom of the trench, the trench shall be over-excavated by not less than two pipe diameters.
- E. Where trenches are over-excavated, or rock is encountered during excavation the trench shall be backfilled and compacted in 6" lifts to the bottom level of the bedding course with a sand/gravel mix with a maximum 3/8" particle size.
- F. Underground drainage piping shall be laid on a 6" of well-tamped bedding course of a sand/gravel mix with a maximum 3/8" particle size. Bedding shall be scooped out at the bells or couplings to ensure the piping is well supported throughout its entire length. Sand/gravel mix should be firmly compacted under, around, and above the pipe in 6" lifts to grade. Compaction should be a minimum of 95 percent of standard proctor according to ASTM D698.
- G. Underground piping installations shall conform with ASTM D2321/F1668 and CISPI 301.
- H. Install piping materials in accordance with the manufacturer's requirements and in conjunction with the standards referenced in this specification. Installation methods shall comply with the more restrictive standards.

3.9 STARTUP, TESTING AND ADJUSTMENTS

- A. Adjust fixtures, equipment, accessories, and moving parts to function smoothly and lubricate as recommended by manufacturer.
- B. Provide necessary power to fixtures, equipment, and accessories to ensure proper functionality.
- C. Complete installation and startup checks according to manufacturer's written instructions.
- D. Perform the following adjustments before operation:
 - 1. Check piping connections for tightness.
 - 2. Close drain valves, hydrants, and hose bibbs.
 - 3. Open shutoff valves to fully open position.
 - 4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 7. Set pre-charge pressure on expansion and accumulator tanks.
 - 8. Adjust and set all temperature, pressure, and flow set points for all fixtures, equipment, and/or accessories as required by authorities having jurisdiction or manufacturers recommendations, whichever carries the highest importance.
 - 9. Charge and test for leaks all plumbing systems, rectify all installation issues prior to putting any systems into service.
 - 10. Test each all backflow-prevention assemblies according to authorities having jurisdiction and the device's reference standard.
 - 11. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 12. Noise Test.
 - 13. Open discharge valve slowly.

3.10 CLEANING EQUIPMENT AND PREMISES

- A. Vacuum, clean and wipe down all new work and equipment inside and out. Exposed parts which are to be painted shall be cleaned of all foreign objects and prepped for paint.
- B. During the progress of work, clean up and leave the premises and portions of the building in which work has occurred in a clean and safe condition. Provide this cleaning on a per-shift basis.

3.11 DEMONSTRATION / TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment. Refer to product specific specification for training types and duration.

End of Section 220501.00

SECTION 220503.00 - SUBMITTALS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Division 22 Common Work Results for Plumbing Piping apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative, content and format requirements for preparation and submission of submittals.
- B. Work of this Section is supplemental and additive to the requirements of Section 013300 where included in the Project Manual.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Payment in full or in part may be withheld from the Contractor for failure to comply with submittal requirements articulated in the Contract Documents.

1.4 SUBMITTALS

- A. Submittals shall be furnished for each Section that includes one or more of the following elements of work:
 - 1. Supply of one or more products.
 - 2. Installation of one or more products.
 - 3. Integration of one or more products.
 - 4. Creation of one or more deliverable products.
 - 5. Labeling of one or more products.
 - 6. Contractor-based design or engineering of one or more products or systems.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Submittals shall be routed through established Project channels as identified by the Owner's representative.

- B. Coordinate, assemble, title, transmit and track Project submittals.
- C. Label each submittal of each type similarly for consistency and so they appear as if prepared by the same entity. Like-type submittals (e.g., Product Data) from different Sections shall feature the same appearance and organization as those of other Sections.
- D. Submittals prepared by subcontractors or vendors shall not be accepted unless prepared in compliance with the Contract Documents and this specification.
- E. Submittal items listed in this Section represent the common items required to be supplied for the various specification Sections throughout the duration of the Project. Individual Sections will vary and may include additional or lesser requirements.
- F. Designer reserves the right to require additional submittals or to waive select submittal requirements on a Section-by-Section basis. Additional submittals shall be provided at the Contractor's expense.
- G. The cost for preparation and transportation of submittals is Work of the Contract.
- H. Bind physical/hardcopy submittals together. Do not submit loose or paper clipped documents.
- I. Supply separate submittals for each Specification Section. Do not combine multiple Sections together into a single submittal, except where expressly directed within the Contract Documents.
- J. Where electronic submittals are required or permitted, comply with the requirements for electronic submittals as identified in the Contract Documents.
- K. Organize submittals as identified in the Contract Documents.
- L. Furnish submittals for different Specification Sections each with its own transmittal form. A single transmittal shall not be used to identify submittals for more than one (1) Specification Section at a time. This allows for tracking and processing efficiency, so that:
 - 1. Each Section may be reviewed simultaneously by different individuals, as appropriate.
 - 2. Individual Sections may be processed and returned more quickly than others when some Sections require longer review times.
 - 3. Submittals that are returned and marked as "Revise and Resubmit" do not cause submittals for other Sections to be also be resubmitted due to the fact that they were bound together as a single unit.
- M. Availability of Electronic Drawings
 - 1. Refer to Common Requirements specification section within this discipline for specifics in regards to obtaining electronic editable versions of drawings for the creation of shop and as-built drawings.

3.2 SUBMITTAL TYPES

- A. The following are the common submittal types referenced in this Section:
 - 1. Product Data (PD).
 - 2. Shop Drawing (SD).

3. Training (TG).
4. Field Observation Response (FO).
5. Closeout Submittal (CO).

3.3 SUBMITTAL SEQUENCE

- A. Product Data Submittal:
 1. Submit following contract award or notice of intent to award a contract. Product data shall be submitted and reviewed prior to procurement of materials.
- B. Shop Drawing Submittal:
 1. Submit for review prior to commencement of fabrication and installation.
 2. Submit concurrently with Section-specific Product Data submittals.
- C. Training Submittal:
 1. Submit thirty (30) days prior to the first training session.
- D. Field Observation Report Submittal:
 1. Submit five (5) business days prior to punch list walkthrough.
- E. Closeout Submittal:
 1. Submit following completion of onsite work but not more than ten (10) business days following successful Acceptance Testing.

3.4 SUBMITTAL IDENTIFICATION

- A. Identify each submittal uniquely.
- B. Identify each submittal by specification Section number, submittal type, and submittal iteration.
- C. The format for labeling the submittals shall be as follows:
 1. Section Number–Submittal Type Abbreviation–Submittal Iteration.
 2. Examples:
 - a. First Product Data Submittal for section 224000: “224000-PD-00.”
 - b. Revised Product Data Submittal for section 224000: “224000-PD-01.”
 - c. Second Revised Product Data Submittal for 224000: “224000-PD-02.”

3.5 SUBMITTAL CONTENTS

- A. All Submittals:
 1. Transmittal:
 - a. Supply a dedicated transmittal for submittals for each individual Section.
 - b. Itemize the specific submittals included by Section, submittal type, and iteration.
 2. Title Sheet:
 - a. Include a separate title sheet with each submittal, of each type.
 - b. Title sheets for each Section, for each submittal type, shall have the same appearance.
 - c. Title sheets for product data submittals shall be 8-1/2 inches x 11 inches.

- d. Title sheets for drawings shall be the same size as the associated drawings.
 - e. Create title sheets to have the appearance and information identified on the sample title sheet published at the end of this Section.
 3. Index:
 - a. Include an index outlining and identifying the contents of the submittal.
 - b. The index for drawing submittals shall be incorporated onto the title sheet of the corresponding drawing set.
 4. Checklists:
 - a. Include the checklist(s) published in the Contract Documents corresponding to the type of submittal being supplied. Applicable checklists are found at the end of this Section and may also be found within individual Sections.
 5. Title Blocks:
 - a. Drawing submittals shall be created on the Contractor's, manufacturer's, or vendor's own title block. The title blocks of the Owner, Architect, Engineer, Designer or their Consultants shall not be reproduced on any document (electronic or hardcopy) that is prepared or altered by the Contractor.
 6. Legend:
 - a. Drawing submittals shall include a legend of symbology.
 7. Resubmittals:
 - a. Resubmittals shall include a replica of the reviewer's comments that necessitated the resubmittal, along with an accompanying item-by-item explanation of the actions taken and changes that will be found within the resubmittal.
- B. Shop Drawing Submittals:
 1. General:
 - a. Drawing descriptions identify the required contents of common drawings required under the Contract.
 - b. Drawings identified within individual Sections, along with any additional drawings deemed necessary by the Designer, are required.
 - c. Drawing Scales:
 - 1) Floor plans shall be drawn to scale.
 - 2) Section drawings shall be drawn to scale.
 - 3) Elevation drawings shall be drawn to scale.
 - 4) Details of physical items shall be drawn to scale.
 - d. Sizes:
 - 1) Sheet sizes shall match the size of the Contract Drawings sheets, except where otherwise expressly requested or approved in advance by the Designer.
- C. Training Submittals:
 1. Proposed schedule.
 2. Training agendas for each session.
 3. Identification of personnel that will conduct training.
 4. Handouts proposed for distribution during training.
- D. Field Observation Report Submittals:
 1. Written responses to Field Observation Reports supplied to the Contractor during the course of the Project:
 - a. The response shall include a copy of the original Field Observation Report.
 - b. The response shall include detail of the corrective action taken, the date the action was taken and the identity of the individual who took the action.

E. Closeout Submittals:

1. As-Built Drawings:
 - a. General:
 - 1) Requirements for Shop Drawings apply to “As-Built” drawings.
 - b. Required Drawings:
 - 1) Title Sheet.
 - 2) Floor Plans.
 - 3) As-built version of each Project shop drawing.
 - c. Drawing Formats:
 - 1) Electronic Editable: Editable version using the native application used to create the file (e.g., Revit, AutoCAD).
 - 2) Non-Editable: PDF file format.
 - 3) Printed Hardcopy.
 - 4) Sheets shall be the same size and feature consistent title block information in the lower-right corner.
 - d. Drawing Organization:
 - 1) Hardcopy drawings shall be bound together into logical sets, bound along the left edge of the sheets.
 - 2) The first page of the set shall include a detailed index and sheet-by-sheet description of each drawing sheet.
2. Operation and Maintenance Manuals:
 - a. Manual Format:
 - 1) Hard-cover 3-ring type binder.
 - 2) Front clear plastic cover pocket complete with Project and system Information insert.
 - 3) Clear plastic spine pocket with Project and system Information insert.
 - 4) Binder sized to suit the contents only, neither oversized nor undersized.
 - 5) Maximum binder thickness: 3 inches.
 - b. Manual Contents and Organization:
 - 1) General:
 - a) Separate binder (or binder set) for each system, labeled. Provide no more than one system per binder (or binder set).
 - b) Separate CD-ROM (or CD-ROM set) for each system, labeled. Provide no more than one system per CD-ROM (or CD-ROM set).
 - c) Do not overfill. Binders shall not be filled beyond an easily usable capacity.
 - d) Insert labeled tabs within binder to identify separate contents of the manual.
 - e) Labeled sub-directories shall be created on the CD-ROM to label and separate contents for the manual.
 - 2) Project Information Cover:
 - a) Title of Project.
 - b) Name and address of Owner, Designer, Architect, Contractor of Record and Subcontractor.
 - c) System name and specification references.
 - 3) Index:
 - a) Contents of the manual.
 - 4) Warranty Statement:
 - a) A warranty statement shall be included for each system. The warranty statement shall reiterate the terms of warranty identified

- within the Contract Documents, as well as identify how the Owner is to obtain warranty service.
- b) The warranty statement shall clearly identify which products are covered by Manufacturer warranties beyond the Contractor required minimum warranty period. The term of manufacturer warranty shall also be identified (e.g., 2 year parts and labor).
 - c) A separate warranty statement shall be supplied for each system.
 - d) Identify the date that the warranty for the system starts. This date shall be the date listed on the Certificate of Substantial Completion (if one was issued to the contractor specifically for the system) or the date listed on the Notice of Final Completion.
 - e) Supply standard out-of-warranty service rates and service contact information.
- 5) Bill of Materials:
 - a) List of products supplied.
 - b) Serial numbers of each product.
 - 6) Product Datasheets (supply only in the electronic version of Operation and Maintenance Manual):
 - a) Manufacturer datasheets for each product supplied.
 - 7) Manufacturer Owner / User Manuals:
 - a) Manufacturer's Owner's or User's manual for each product.
 - b) Manufacturer's Installation instructions and other documentation supplied with the product.
 - 8) Test Reports and Checklists:
 - a) Test reports, checklists, and other forms generated and completed during the course of the Project.
 - 9) As-Built Drawings:
 - a) The hardcopy manual shall contain reduced scale printed version (11x17) of system-specific drawings.
 - b) The electronic manual shall contain electronic PDF version of the as-built drawings.

3.6 SUBMITTAL QUANTITY

A. General:

- 1. The quantity of submittals required shall be the greater of the following:
 - a. Quantity identified within Division 01.
 - b. Quantity identified within the individual Section.
 - c. Quantity identified herein.
- 2. In addition to the Contract required quantity, the Contractor shall also submit any additional quantities required for its own use and records, and for distribution to other trades.
- 3. The Designer shall retain a copy of each submittal received. Others in the submittal communication chain may also retain copies.

B. Product Data Submittals:

- 1. Two (2) Hardcopies.
- 2. One (1) Electronic.

C. Shop Drawings Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

D. Field Observation Report Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

E. Samples Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

3.7 SUBMITTAL REJECTION

A. The following items are representative reasons that submittals may need to be revised and resubmitted:

1. Binding submittals for multiple Sections together.
2. Failing to supply separate transmittal for submittals for each Section.
3. Failing to include a submittal title sheet.
4. Failing to use and accurately complete the published title sheet.
5. Failing to supply and accurately complete the submittal checklists.
6. Failing to supply product data and shop drawings at the same time.
7. Failing to supply product data sheets.
8. Failing to supply product data sheets with the correct product and required accessories enumerated.
9. Failing to supply shop drawings.
10. Failing to supply shop drawings with required information.
11. Failing to supply accurate information.
12. Failing to supply relevant information required by the Specifications.
13. Failing to supply products that are in compliance with the Specifications.
14. Failing to supply the required information in the required format.

3.8 RESUBMITTALS

A. Revise and Resubmit:

1. When a submittal is rejected and flagged as "Revise and Resubmit," the entire submittal shall be reviewed, revised and resubmitted in totality.
2. Resubmittals shall be checked for compliance with the Contract Documents, inclusive of requirements for submittals. In addition, any comments and deficiencies identified by the reviewer shall be appropriately acted upon.

B. Exceptions Noted:

1. When a submittal is flagged as "Exceptions Noted," the specific actions identified shall be taken.
2. If the reviewer's comments include selective rejection of products, the resubmittal shall be limited to include those items commented upon.

C. Resubmittals shall:

1. Include a copy of the reviewer's previous comments.
2. Include a written description of the action(s) taken.

3. Be labeled chronologically.
4. Be inclusive of all corrective action identified by the previous reviewer.

3.9 ELECTRONIC SUBMITTALS

- A. Electronic submittals shall only be permissible where electronic submittals are expressly required and where express approval for such has been granted.
- B. Electronic submittal files shall be compatible for opening and viewing with electronic PDF file readers that fully support and recognize the Adobe PDF Portable Document Format Standard, version 1.5.
- C. Major text within the files shall be electronically searchable using the search-for-text features of current generation Adobe PDF reader software. Files shall be prepared in such manner that reviewers will have the option to search for and find words and phrases that appear within the document, electronically. Documents featuring raster-based text and text that is otherwise not searchable shall not be acceptable. This precludes the use of documents that have been electronically scanned and then converted to or embedded within an electronic file.
- D. The organization, contents, and labeling of information along with other requirements for submittals apply also to electronic versions of the submittals.
- E. Single File Submission:
 1. Option 1 – Single File, PDF Format:
 - a. Single PDF file submittals shall be assembled from a series of individual files that are organized, indexed, bound together as one composite file that is bookmarked to aid the reviewer in navigating the content.
 - b. The file shall feature a navigational tree of contents, organized by content groups (e.g., Title Page, Index, Datasheets, Shop Drawings). Content groups shall be organized in the same relative order identified within the Contract Documents.
 - c. Within each content group shall be the supporting elements of the group (e.g., product datasheets under the Datasheets group). Each element of the content group shall appear separately as a subordinate element of the group (e.g., separate entry for each product datasheet, separate entry for each shop drawing), and viewable from the navigational contents tree.
 - d. Under the Datasheets content group, individual product datasheet entries shall be identified by Make/Brand and Model. Entries shall be organized in a sorted manner, first by make, then by model.
 - e. If the resulting size of the composite PDF file exceeds 10 Megabytes, supply the submittal using the Single Zip File method instead, as described in this Section.
 - f. The file name used to label the submittal shall be the section number followed by the submittal instance number for that Section (e.g., 224000-PD-01.pdf).
 - 1) Where the Designer directs the supply of multiple zip files for a submittal, add additional text to the file name to identify that the file is part of a multi-file set of submittals, as per the following examples:
 - a) 224000-PD-01 (1 of 3).pdf
 - b) 224000-PD-01 (2 of 3).pdf
 - c) 224000-PD-01 (3 of 3).pdf
 2. Option 2 – Single File, Zip Format:

- a. Single Zip File submittals shall be assembled from a series of individual PDF files and file directories that are contained with a single compressed WinZip compatible “.zip” file.
- b. The file shall contain separate top-level directories that are used to group related content (e.g., 00-Title Page, 01-Index, 03-Datasheets, 04-Shop Drawings), with each directory appearing in the same relative order as that identified in the Contract Documents.
- c. Within each content group directory shall be separate PDF-compliant files featuring the information required (e.g., separate datasheet file for each product, separate file for each drawing).
- d. Product datasheet files shall be named using a consistent naming convention that enables those files to appear sorted and grouped when the file is opened for navigation, viewing or extraction by the reviewer.
- e. Product datasheet files shall be consistently named with the make/brand of the product, followed by model number, followed by any additional information beneficial.
- f. Consult the Designer for supplement instructions should the WinZip file exceed 50 Megabytes in size.
- g. The file name used for the submittal shall be the Section number followed by the submittal instance number for that Section (e.g., 224000-PD-01.zip).
 - 1) Where the Designer directs the supply of multiple zip files for a submittal, add text to the file name that identifies the file is part of a multi-file set as per the following examples:
 - a) 224000-PD-01 (1 of 3).zip
 - b) 224000-PD-01 (2 of 3).zip
 - c) 224000-PD-01 (3 of 3).zip

End of Section 220503.00

SUBMITTAL TITLE SHEET

EXAMPLE

(Form: Sub-1)

PROJECT TITLE:

Project Name Line 1

Project Name Line 2

Project Name Line 2

SUBMITTAL TYPE:

Product Data

SECTION SUBMITTAL NUMBER

224000.00-PD-00

SECTION TITLE:

Plumbing Fixtures

Date Prepared:

yyyy-mm-dd

CONTRACTOR OF RECORD:

Firm Name

Address 1

Address 2

City, State, Zip

Phone (000) 000-0000, Fax (000) 000-0000

Project Manager: Full Name

PM E-Mail: xxxxxxxx@xxxx.xxx

SECTION SUBCONTRACTOR(S):

Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxx@xxxx.xx	Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxx@xxxx.xx

**PRODUCT DATA SUBMITTAL
CHECKLIST**
(Form: Sub-2)

Each line below featuring text shall be supplied with an answer.

	No	Yes
Transmittal		
Title Sheet		
Project Name		
Specification Section number		
Submittal iteration number <i>(0 for first iteration, 1 + for each subsequent iteration (e.g., 224000-0, 224000-1))</i>		
Contractor of Record identified		
Sub-contractor / vendor / supplier name identified		
Title Sheet appearance consistent with sample title sheet		
Checklists included		
This checklist		
Checklists from Section being submitted (where applicable)		
Previous submittal review, with contractor actions and comments		
Product Datasheets included		
Datasheets are manufacturer originals		
Datasheets for each product included		
Section paragraph and/or Drawing reference on each datasheet		
Product accessories and options identified		
Products organized by paragraph (or alphabetically by brand)		
No photocopies, faxes and other illegible datasheets included		
Shop Drawings included		
Shop drawings accompany this product data submittal.		
This submittal contains product data for one Section only.		

This checklist serves as a simple and abbreviated reminder of the contents and format of the aforementioned submittal. Refer to Section 220503 "Submittals for Plumbing" and each specific Section for additional submittal requirements. Submittals are subject to rejection if this checklist is not accurately completed and provided along with the specified information. Reproduce this checklist and submit with each submittal for each Section.

SECTION 220505 - EXISTING CONDITIONS AND DEMOLITION

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 DESCRIPTION OF WORK

- A. Prior to submitting a bid, the Plumbing Contractor shall perform a detailed walk-through field inspection, to review the existing structures and premises, to determine all existing conditions, equipment/ piping locations, etc. and shall make all necessary allowances for all required Plumbing related demolition and relocation work. This pre-bid inspection by the Plumbing Contractor shall include inspection of all applicable accessible ceiling cavity, areas, etc.
- B. Should the Plumbing Contractor take any exceptions to providing any related demolition or relocation work, such exceptions shall be stated in detail within the Prime Contractor's bid. No subsequent allowance to the contract cost shall be made for any insufficient allowances made by the Plumbing Contractor during bidding which may result from the Plumbing Contractor's failure to visit job site and review drawings.
- C. Demolition related work may not be specifically indicated on drawings but shall be included under base bid. All Plumbing related demolition, relocation, etc. work, including work described herein, shall be under base bid.
- D. It is not the intent of these contract documents that existing conditions be accurately shown. Existing Plumbing work is shown to a limited extent on drawings and is shown for general planning reference only. Such locations, etc. have been located from portions of contract documents which were prepared for previously installed work (not from "as-builts"). These locations are not guaranteed. The successful Plumbing Contractor shall have access to all available existing building/system plans and specifications.
- E. The existing plumbing systems may be utilized only to the extent indicated herein or on drawings and/or as directed by Owner's representative in field.
- F. Routing of all new plumbing systems in existing buildings shall be approved by Owner's representative prior to installation.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 EFFECT ON ADJACENT OCCUPIED AREAS

- A. Locate, identify, and protect existing Plumbing services passing through demolition areas and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. It is recognized that there may be some systems rendered inactive by demolition, causing disconnection of "downstream" branches, equipment, etc. which serve occupied areas. It shall be the responsibility of the Plumbing Contractor to investigate these types of conditions (for all systems) prior to demolition. Provide all necessary corrective Plumbing work prior to demolition to ensure that such "downstream" work remain permanently active throughout demolition, new construction and after project completion.
- C. All work and system shutdowns shall be carefully coordinated in advance with owner's representative and all affected trades so that normal building activities and other construction trades are minimally affected. All required Plumbing related demolition and/or new construction work, which will affect any and all occupied areas (including those which are located outside the immediate area of project work) shall be performed at special times if/as directed by Owner's representative in field.
- D. All existing systems and components shall remain fully operational in all occupied spaces during all occupied periods.
- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent finished areas and/or other system components. During cutting and patching operations, protect adjacent installations. Remove protection and barriers after demolition operations are complete.

3.2 WORK IN EXISTING SPACES

- A. General: Care shall be taken when working in existing spaces so as not to damage existing walls and ceilings where work is being performed.
- B. Existing Ceilings: Where work is being performed above ceilings, and the architectural drawings do not indicate ceiling modifications by the General Contractor, it shall be the responsibility of this contractor to remove and replace existing ceilings where work is being performed. In those instances, all repair and installation of new grid, ceiling panels, etc shall be the responsibility of this contractor. Match existing finishes.
- C. Walls & Floors: It shall be the responsibility of this contractor to patch existing walls and floors and match existing finishes where work is being removed or installed and patching is being performed, unless noted otherwise on the architectural drawings.

3.3 GENERAL DEMOLITION

- A. Provide complete Plumbing demolition as required for all systems throughout all project areas not indicated to be salvaged or saved. Unless specifically noted otherwise on plans or determined otherwise during this contractor's pre-demolition survey, all abandoned existing

Plumbing work in the project areas shall be disconnected and removed in its entirety by the Plumbing Contractor. All related work shall comply with the notes specified herein.

- B. Provide demolition work as required to clear and remove all existing Plumbing work to be abandoned and as required to accommodate all new work of all trades. In general, remove existing related piping, control media, etc. back to nearest concealed accessible terminal or take-off "upstream". Extend piping, etc. as required to accommodate new or relocated Plumbing work.
- C. All demolished piping shall be capped back to active source(s) per contract drawings, even if source(s) are outside of the confines of the project area. Coordinate all demolition work carefully with Owner prior to the start of construction.
- D. Perform cutting and patching required for demolition in accordance with the contract documents.
- E. All piping, etc. conflicting with construction related work of any and all trades shall be removed and/or relocated by the Plumbing Contractor as necessary and/or as directed by Owner's representative in the field. Plumbing disconnections (and/or reconnections) for equipment to be removed (and/or relocated) shall be by the Plumbing Contractor. This shall apply to all existing Plumbing work whether shown on drawings or not.
- F. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- G. Provide new work as required to accommodate relocations, etc. Routing of all new and piping in existing buildings shall be held tight to structure above wherever possible and shall be approved by owner's representative prior to installation.

3.4 DISPOSITION OF REMOVED EQUIPMENT & MATERIALS

- A. Except where specifically noted otherwise herein or on drawings, all Plumbing work shown on new work plans shall be new.
- B. If required to accommodate construction related activities, remove and reinstall any conflicting fixtures, devices or equipment that are to remain.
- C. All abandoned materials removed during demolition and thereafter shall be referred to the Owner's representative for disposal instructions. All materials which the Owner elects to retain shall be neatly stored at the site by the Plumbing Contractor as designated by the Owner's representative. All materials which the Owner elects not to retain shall be disposed of by the Plumbing Contractor in a lawful manner.
- D. All fixtures, devices or equipment designated for salvage (removal and reuse, or for turning over to Owner) shall be disconnected and removed undamaged. Disconnect all pigtails, etc. from equipment terminal points and carefully transport and neatly store same to a protected on-site storage location as directed in field.
- E. Components to be reused shall be cleaned (inside and out) and reinstalled where indicated on drawings. Modify and/or extend related existing ductwork and/or piping as required.

- F. Components turned over to Owner shall be neatly stored as groups by system type.

3.5 PRE-EXISTING CODE VIOLATIONS

- A. All existing work which is accessed and/or used under this project shall be inspected and brought into compliance with current codes and standards by the Plumbing Contractor. This shall apply only to the extent that such work is uncovered in the immediate project areas affected by demolition and/or new construction and only to the limited extent that it applies to pre-existing general installation methods (i.e. a missing hanger/support, a missing seal and other minor incidental work).
- B. If more extensive code or safety violations are discovered by the Plumbing Contractor, they shall be immediately brought to the attention (detailed in writing) of the Owner's representative along with the contractors proposed cost for corrections.

3.6 INTERIM LIFE SAFETY WORK

- A. Provide interim fire protection (sprinkler) work in all demolition and construction areas for full code coverage. Further definition will be provided in field if required.

End of Section 220505.00

SECTION 220517.00 - SLEEVES AND SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data:
 - 1. Provide product datasheets for all products specified under this section.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.2 STACK-SLEEVE FITTINGS

- A. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
 - 6. Link-Seal Modular Seals
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Presealed Systems.
2. Advance Products & Systems, Inc.
3. CALPICO, Inc.
4. Metraflex Company (The).
5. Pipeline Seal and Insulator, Inc.
6. Proco Products, Inc.
7. Link-Seal Modular Seals

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

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install rockwool and/or caulk between pipe and sleeve. Material must meet all applicable fire ratings.
- E. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
- B. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
- C. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
- D. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
- E. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- F. Using grout, seal the space around outside of stack-sleeve fittings.
- G. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Galvanized-steel-pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade:
 - a. Stack-sleeve fittings
 - b. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
 - 5. Interior Partitions:
 - a. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

End of Section 220517.00

SECTION 220518.00 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data:
 - 1. Provide product datasheets for all products specified under this section.
 - 2. Clearly state model numbers on all submittals.
 - 3. Sustainable Design: LEED submittals conforming to requirements listed in Section 013329.02 "Sustainable Design Reporting - LEED v4":
 - a. Provide the following documentation: NSF 61 and NSF 372 certification, lead free, or other documentation as defined in "Sustainable Design Reporting - LEED v4".

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. Hinged or Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- C. Manufacturer's: Subject to compliance with requirements available manufacturer's offering products that may be incorporated into the work include, but limited to the following:
 - 1. AWI
 - 2. Brass Craft
 - 3. Mcguire Manufacturing Co., inc.
 - 4. Watts
 - 5. Pro-Flo

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Provide escutcheons with ID to closely fit around pipe, tube, and/or insulated piping and with OD that completely covers rough penetration opening of walls, ceilings, floors, casework, surrounds, and countertops in finished spaces.
 - 1. Escutcheons for
 - a. New piping with fitting or sleeve protruding from wall: One-piece, deep-pattern type.
 - b. New bare and/or insulate piping at wall, floor, and ceiling penetrations in finished spaces: Hinged or split-cast, shallow-pattern type.

- c. Fixtures and valve bodies in finished spaces.

3.2 FIELD QUALITY CONTROL

- A. Replace broken, damaged, and/or missing escutcheons using new materials.

End of Section 220518.00

SECTION 220519.00 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data:
 - 1. Provide product datasheets for all products specified under this section.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories, and model numbers on all submittals

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Trerice, H. O. Co.
 - c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 6-inch nominal size.
 - 4. Case Form: Back angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 7. Window: Glass or plastic.
 - 8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 9. Connector: 3/4 inch, with ASME B1.1 screw threads.
 - 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Trerice, H. O. Co.
 - c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 2. Standard: ASME B40.100.
 - 3. Case: Liquid-filled types; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade C, plus or minus 3 percent of middle half of scale range.

2.3 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

2.4 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. National Meter, Inc.
 3. Trerice, H. O. Co.
 4. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.5 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Trerice, H. O. Co.
 - c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
- B. Furnish one test-plug kit containing one thermometer, one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- B. Install valve and snubber in piping for each pressure gage for fluids.
- C. Install test plugs in piping tees.
- D. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlet of hot water recirculation pumps.
 - 3. Inlets and outlet of master mixing valve.
- E. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. At highest point in piping system.
 - 3. Inlet and outlet of each backflow preventer.
 - 4. Suction and discharge of each domestic water booster pump.
- F. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.2 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.4 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 160 psi.
- B. Scale Range for Domestic Water Piping: 0 to 160 psi.

End of Section 220519.00

SECTION 220523.00 - GENERAL-DUTY VALVES FOR PLUMBING 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. Section Includes:
 - 1. Bronze ball valves.
 - 2. Iron, single-flange butterfly valves.
 - 3. Bronze swing check valves.
 - 4. Automatic balancing valves
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

- B. Sustainable Design: LEED submittals conforming to requirements listed in Section 013329.02 "Sustainable Design Reporting - LEED v4":
 - 1. Provide the following documentation: NSF 61 and NSF 372 certification, lead free, or other documentation as defined in "Sustainable Design Reporting - LEED v4".

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

- D. Source Limitations for Valves: Provide project valves from a single source and manufacturer.
- E. Valves in Insulated Piping: With **2-inch** stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. Pressure Rating: 200 psi @ 250°F.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze, lead-free dezincification-resistant.
 - e. Seats: PTFE or TFE.
 - f. Stem: Bronze, blowout-proof.
 - g. Ball: Chrome-plated brass.
 - h. Port: Full.
 - i. Adjustable packing gland.
 - j. Vinyl-covered steel handle.

2.3 BRONZE SPRING CHECK VALVES

- A. Y-pattern, Bronze Spring Check Valves with Bronze Disc rated 250 psi non-shock CWP:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 250 psig.
 - c. Body Material: ASTM B 62, bronze.
 - d. Ends: Threaded or solder-type.
 - e. Disc: Bronze.

2.4 AUTOMATIC BALANCING VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acorn Engineering Co.
 - 2. Caleffi, North America, Inc.
 - 3. ThermOmegaTech
- B. Body: [303 Stainless Steel] [DZR low-lead brass] [Bronze]
- C. Adjustable cartridge: stainless steel & copper
- D. Piston and Spring Assembly: 302 Stainless steel, tamper proof, self-cleaning and removable.
- E. Maximum CWP rating: 200 psi
- F. Maximum Operating Temperature: 195 deg. F.
- G. Standard: NSF/ANSI 61
- H. Integral and cartridge-style check with accessible screens to prevent backflow and to filter debris from entering the valve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Set ball and plug valves open to minimize exposure of functional surfaces.
- C. Orient check valves in correct direction of flow.

1. Mount swing checks in a horizontal position so the check will swing into closed position in a no-flow situation.
 2. Spring checks can be mounted in the horizontal and vertical position.
- D. Locate valves for easy access and provide separate support where necessary.
- E. When feasible, install ball valves in horizontal piping with stem at or above center of pipe.
- F. Install valves in position to allow full stem and handle movement.
- G. Install check valves for proper direction of flow and as follows:
1. Spring Check Valves: In horizontal or vertical position.
- H. Provide union and isolation valve immediately upstream and downstream of each balancing valve.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 DOMESTIC WATER VALVE SCHEDULE

- A. Where specific valve types are not indicated, the following requirements apply:
- B. Isolation/Control Valves
1. All valves installed in domestic water piping 3" and smaller shall be ball valves.
 - a. [Ball Valves - 2 Inch and Smaller: 2-piece body. Provide extended valve stems for valves used on insulated lines. Provide equal to Nibco Series 585-80-LF.
 - b. Ball Valves – 3 Inch: 3-piece body. Provide extended valve stems for valves used on insulated lines. Provide equal to Nibco Series 595-Y-LF.
- C. Check Valves
1. Provide solder end check valves on each domestic hot and cold water service piping. Provide check valves equal to Nibcon T-480-Y-LF.
 2. Provide a spring (silent) check valve immediately downstream of the main water service reduced pressure backflow preventer when a booster pump is installed on the domestic water system.
 3. Provide check valve on each domestic Provide solder end check valves on domestic hot and cold water service piping. Provide check valves equal to Nibcon T-480-Y-LF.
 4. hot and cold water supply to thermostatic mixing valves, mop sinks and three compartment sinks.
 5. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- D. System Drain Valves: Lead-free hose-end drain valves.

End of Section 220523.00

SECTION 220529.00 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data: For each type of product.
 - 1. Include construction details, rated capacities, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Clearly state model numbers on all submittals.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon or stainless steel.
- B. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.
 - 3. For vertical piping NPS 2 and smaller: Van (Bell) hangers; Carbon steel, copper plated with epoxy coating and stainless steel screw. Size to match pipe size.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Anvil International, Inc.
 - 2. Elcen Metal Products Co.
 - 3. PHD Manufacturing, Inc
 - 4. National Pipe Hanger Corp.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ERICO International Corporation.
 - 2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 3. Rilco Manufacturing Co., Inc.
- B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head
 - c. MKT Fastening, LLC
 - d. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc
 - b. ITW Ramset/Red Head
 - c. MKT Fastening, LLC
 - d. Powers Fasteners

2.5 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof and floor-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for floor and roof installations without membrane penetration.
- C. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for floor and roof installations without membrane penetration.
 - 2. Base: Plastic or stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- D. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for floor and roof installations without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- E. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.
- F. Manufacturers: Subject to compliance with these specifications, pipe support systems shall be Dura-Blok; Cooper B-Line, Inc., Anvil International, MIFAB.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.
- B. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water.
- C. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- D. Provide lateral bracing, to prevent swaying, for equipment supports.
- E. Concrete bases shall extend at least 4" beyond the bed or frame of the supported machine. Equipment bases shall have straight and finished sides and a 1"-45 degree chamfer at the top. Reinforcing steel bars (Type #4) shall be placed in a grid pattern in both directions of the base spaced at 12" on center.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
- B. Do not suspend hangers from roof decks. Suspend from roof trusses, joists and joist girders only at panel points and at top chords unless otherwise indicated.
- C. All piping hangers in exterior spaces, such as parking garages, exposure to high humidity, etc., or in interior swimming pool areas shall be galvanized.
- D. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- E. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- F. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- G. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.
- H. Use padded hangers for piping that is subject to scratching.
- I. All plumbing equipment shall have concrete bases and/or structural steel supports and shall be provided by this contractor.
- J. The use of pumps or other equipment as piping supports shall be prohibited. All such connectors and their supports shall be independently supported from the building structure and inspected and approved by the Engineer before bolting.
- K. Piping connections to all equipment with moving parts shall be isolated with braided copper or stainless steel flexible links, which shall be selected to absorb the deflection on the isolating members.

- L. Use thermal-hanger shield inserts for insulated piping and tubing.
- M. Hanger and support types:
 - 1. Hangers: Provide adjustable, Steel Clevis Hangers (MSS Type 1) for suspension of non-insulated or insulated, stationary pipes.
 - 2. Horizontal-Piping Clamps: Provide Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3) for suspension of pipes requiring clamp flexibility and up to 4 inches of insulation.
 - 3. Vertical-Piping Clamps: Provide extension pipe or Riser Clamps (MSS Type 8) for support of pipe risers.
- N. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- O. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Inserts:
 - a. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from structural concrete ceiling.
 - 2. Clamps:
 - a. C-Clamps (MSS Type 23): For structural shapes.
 - b. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - 3. Miscellaneous:
 - a. Welded Beam Attachments (MSS Type 22): For attaching to bottom of steel beams if loads are considerable and rod sizes are large.
 - b. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - 1) Light (MSS Type 31): 750 lb.
 - 2) Medium (MSS Type 32): 1500 lb.
 - 3) Heavy (MSS Type 33): 3000 lb.
 - c. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - d. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- P. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- Q. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

- S. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- T. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- U. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- V. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- W. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- X. Install lateral bracing with pipe hangers and supports to prevent swaying.
- Y. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, expansion joints, strainers and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- Z. Provide pipe rollers for hot water mains. Provide pipe rollers approved equal to Anvil Fig. 171, 175, 177, 181 and 271.
- AA. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- BB. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- CC. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation. Do not exceed pipe stresses allowed by manufacturer.
 - b. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - c. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

- d. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Shields:
 - a. Install protective galvanized steel shields, MSS Type 40, on insulated piping smaller than 2-inch NPS. Shields shall span an arc of 180 degrees and shall be a minimum of 12-inches in length.
 - b. Install thermal-hanger shield inserts on all insulated piping 2-inch NPS and larger.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 6: 18 inches long and 0.06 inch thick.
 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
 6. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 7. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 8. Vertical Piping: MSS Type 8 or Type 42, clamps.
 9. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 10. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 11. Base of Vertical Piping: MSS Type 52, spring hangers.
- DD. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- EE. Support vertical piping and tubing at base and at each floor.
- FF. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- GG. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- HH. Install supports for vertical cast-iron soil piping every 15 feet.
- II. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 and NPS 4: 10 feet with 1/2-inch rod.

- JJ. Install supports for vertical copper tubing every 10 feet.
- KK. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- LL. Install supports for vertical PVC piping every 48 inches.
- MM. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting", Section 099123 "Interior Painting" or Section 099600 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Piping:

Piping Material	Pipe Size	Hanger Spacing (OC)	Vertical Support (OC)
Cast Iron	Any	5'-0"	15'-0"
Ductile Iron	Any	5'-0"	15'-0"
Copper	1-1/4" and smaller	6'-0"	10'-0"
Copper	1-1/2" and larger	10'-0"	10'-0"
PVC	Any	4'-0"	10'-0"
CPVC	1" and smaller	3'-0"	10'-0"
CPVC	1-1/4" and larger	4'-0"	10'-0"
Polyethylene Piping (PE)	Any	2'-6"	10'-0"
Steel	Any	12'-0"	15'-0"

1. In addition to supported pipe information above, support piping at each change in direction.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

End of Section 220529.00

SECTION 220553.00 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data: For each type of product.
 - 1. Provide product datasheets for all labels, signs, valve tags, and warning tags.
- B. Closeout Submittals (CO):
 - 1. Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.
- E. Pipe Label Color Schedule:
 - 1. Domestic Cold Water, Hot Water, Hot Water Return, Drain, Waste, and Vent:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 2. Fuel Gas Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - 3. Medical Air Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved 1-1/2 inch diameter brass with 1/4-inch stamped letters for piping-system abbreviation and 1/4-inch alphanumeric lettering.
 - 1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain.
 - 3. Associated piping system.
 - 4. Location of valve (architectural room name and/or number).
 - 5. Normal-operating position (open, closed, or modulating).
 - 6. Identify special or unique characteristics (emergency shutoff).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Locate equipment labels where accessible and visible. Install or permanently fasten labels on each major item of mechanical equipment. Install identifying devices with completion of covering and painting of surfaces where devices are to be applied, locations of access panels and doors, and acoustical ceilings or similar concealment.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

End of Section 220553.00

SECTION 220593.00 - TESTING, ADJUSTING AND BALANCING FOR PLUMBING SYSTEMS

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 specifies the requirements and procedures total plumbing systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the plumbing systems as required to meet design specifications, and recording and reporting the results.
- B. Test, adjust, and balance the following plumbing systems:
 - 1. Hot Water Return Systems
 - 2. Additional Tests
- C. Related Sections:
 - 1. Section 22 05 03 "Submittals for Plumbing".

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate at the terminal equipment, such as to reduce pump speed or adjust a valve.
- B. Balance: To proportion flows within the distribution system, including submains and branches, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of fluid.
- D. NC: Noise criteria.
- E. NEBB: National Environmental Balancing Bureau
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. Report Forms: Test data sheets for recording test data in logical order.
- H. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- I. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

- J. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- K. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a pump when installed under conditions different from those presented when the pump was performance tested.
- L. TAB: Testing, adjusting, and balancing.
- M. Test: A procedure to determine quantitative performance of systems or equipment.
- N. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 ACTION SUBMITTALS

- A. Agency Data
 - 1. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1.
- C. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
 - 1. Final Report: Upon verification and approval prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.
 - 2. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - a. General Information and Summary
 - b. Sump pumps
 - c. Domestic Hot Water Return Systems
- D. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of evidence that the TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- E. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of the Contract Documents review report as specified in Part 3.

- F. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- G. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- H. Sample Report Forms: Submit two sets of sample TAB report forms.

1.5 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. AABC: "National Standards for Total System Balance".
 - 2. ASHRAE: ASHRAE Handbook, Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.
- B. Agency Qualifications
 - 1. The Plumbing Contractor shall procure the services of an independent Balance and Testing Agency, approved by the Engineer, and a member of NEBB, which specializes in the balancing and testing of plumbing systems, to balance, adjust and test all water systems and equipment as herein specified.
 - 2. All work by this agency shall be done under direct supervision of a qualified plumbing Engineer employed by this agency.
 - 3. All instruments used by this agency shall be accurately calibrated and maintained in good working order.
- C. The Balance and Testing Agency must provide the technicians with the following instruments including, but not limited to, for field use:
 - 1. One set of pressure gages and fittings.
 - 2. Thermocouple unit and thermocouples.
 - 3. Set of balancing cock adjustment wrenches.
 - 4. Portable field flowmeter.
- D. TAB Firm Qualifications: Engage a TAB firm certified by NEBB.
- E. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
 - 2. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

- a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - b. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- F. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or TAB firm's forms approved by Architect.
- G. Instrumentation Type, Quantity, and Accuracy: Required Instrumentation for NEBB Certification."
- H. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 SEQUENCING AND SCHEDULING

- A. Systems shall be fully operational prior to beginning procedures.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, controls installers, and other mechanics to operate plumbing systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on plumbing systems have been satisfactorily completed.

1.8 GUARANTEE

- A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

1.9 COMMISSIONING

- A. An independent third-party Commissioning Agent will document completion of the Plumbing Systems. The Construction Manager and Division 22 Contractor(s) are members of the Commissioning Team and will facilitate completion of the Commissioning process. Refer to

Section 019113 Building Systems Commissioning for the project Commissioning requirements and roles and responsibilities of each member of the Commissioning Team.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper testing and balancing of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings. Note the locations of devices that are not accessible and/or deficiencies exist within the design of the contract drawings to allow for proper testing and balancing prior to installation.
- C. Examine the reviewed submittals for plumbing systems and equipment.
- D. Examine system and equipment installations and verify that field quality control testing, cleaning and adjusting specified in individual system and equipment Sections.
- E. Examine plumbing equipment and verify that bearings are greased and equipment with functioning controls are ready for operation.
- F. Examine operating safety interlocks and controls on plumbing equipment.
- G. Report deficiencies discovered before and during performance of the testing and balancing procedures. Observe and record system reactions to changes in conditions. Record default setpoints if different from indicated values.
- H. Verify the domestic hot water return system is correctly balanced to ensure all hot water return loop(s) maintain the designed set delivery temperature.

3.2 PRELIMINARY PROCEDURES FOR PLUMBING SYSTEM BALANCING

- A. Examine valves for proper installation and function.
- B. Examine equipment performance data including pump curves.
- C. Open valves to full open position.
- D. Remove, clean and reinstall all strainers.
- E. Lubricate all motors and bearings.

3.3 PREPARATION

- A. Prepare a testing and balancing plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Prepare system-readiness checklists for use by systems installers in verifying system readiness for T&B. These shall include, at a minimum, the following:
 - 1. Piping is complete with terminals installed.
 - 2. Systems are flushed, filled and air purged.
 - 3. Strainers are pulled and cleaned.
 - 4. Shutoff and balance valves have been verified to be 100 percent open.
 - 5. Pumps are started and proper rotation is verified.
 - 6. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - 7. Variable-frequency controllers' start-up is complete and safeties are verified.
 - 8. Suitable access to balancing devices and equipment is provided.

3.4 MEASUREMENTS

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

3.5 PERFORMING TESTING, ADJUSTING, AND BALANCING

- A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
- B. Cut insulation and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
 - 1. Patch insulation and housings using materials identical to those removed.
 - 2. Seal piping after testing. Then test for leaks and repair if found.
 - 3. Seal insulation to re-establish integrity of the vapor barrier.
- C. Mark equipment settings, including valve indicators and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- D. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.6 GENERAL PROCEDURES FOR PLUMBING SYSTEMS

- A. Prepare test reports for pumps. Obtain approved submittals and any manufacturer-recommended testing procedures.

- B. Verify that hydronic systems are ready for testing and balancing:
 - 1. Check liquid level in expansion tank.
 - 2. Check that makeup water has adequate pressure to highest vent.
 - 3. Check that valves are in their proper position.
 - 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 - 5. Verify that motor starters are equipped with properly sized thermal protection.
 - 6. Check that air has been purged from the system.
- C. Adjust pumps to deliver total design gpm.
 - 1. Measure total water flow.
 - a. Position valves for full flow through valves.
 - b. Measure flow by main flow meter, if installed.
 - c. If main flow meter is not installed determine flow by pump total dynamic head (TDH) or exchanger pressure drop.
 - 2. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - e. With all valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
 - 3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- D. Adjust flow measuring devices installed in mains and branches to design water flows.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- E. Adjust flow measuring devices installed at terminals for each space to design water flows.
 - 1. Measure flow at all balancing valves.
 - 2. Adjust each terminal to design flow.
 - 3. Re-measure each terminal after all have been adjusted.
- F. For systems with pressure-independent valves:
 - 1. Measure differential pressure and verify that it is within manufacturer's specified range.
 - 2. Perform temperature tests after all flows have been verified.

- G. For systems without pressure-independent valves:
 - 1. Measure and balance by pressure drop or temperature method.
 - 2. If balanced by pressure drop, perform temperature tests after all flows have been verified.
- H. Verify final system conditions as follows:
 - 1. Re-measure and confirm that total water flow is within design.
 - 2. Re-measure all final pumps' operating data, TDH, volts, amps, static profile.
 - 3. Mark all final settings.
- I. Verify that all memory stops have been set.

3.7 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Phase/Hertz (Hz)
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter size and thermal-protection-element rating.
 - 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test the manual bypass of the controller to prove proper operation.

3.8 FINAL TEST AND BALANCE REPORT

- A. The report shall be a complete record of the plumbing system performance, including conditions of operation, items outstanding, and any deviations found during the T&B process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the test and balance engineers.
- B. The report must be organized by systems and shall include the following information as a minimum:
 - 1. Title Page:
 - a. NEBB certified company name
 - b. Company address
 - c. Company telephone number
 - d. Project identification number
 - e. Location
 - f. Project Architect
 - g. Project Engineer

- h. Project Contractor
 - i. Project number
 - j. Date of report
 - k. NEBB Certification Statement
 - l. Name, signature, and certification number of TBE
 2. Table of Contents.
 3. National Performance Guaranty.
 4. Report Summary:
 - a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.
 5. Instrument List:
 - a. Type.
 - b. Manufacturer.
 - c. Model.
 - d. Serial Number.
 - e. Calibration Date.
 6. T&B Data
- C. One copy of the final test and balance report shall be sent to the engineer of record. Provide five additional copies to the contractor.

3.9 VERIFICATION OF T&B REPORT

- A. Final Verification:
 1. After testing and balancing is complete and accurately documented in the final report, request that a final verification be made by the engineer of record
 2. The engineer of record shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 3. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 4. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final verification, the testing and balancing shall be considered incomplete.

3.10 REVERIFICATION

- A. T&B Agency shall recheck all measurements and make adjustments as required to complete the balancing. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second verification.

- B. If the second verification also fails, the engineer of record may contact NEBB Headquarters regarding the NEBB National Performance Guaranty.

3.11 ADDITIONAL TESTS

- A. Seasonal Periods: If initial T&B procedures were not performed during near-peak conditions, the engineer of record may request a flow recheck to further verify performance at near-peak conditions.

End of Section 220593.00

SECTION 220719.00 - PLUMBING SYSTEMS INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Related Sections:

1. Section 013329.02 – Sustainable Design Reporting - LEED v4.
2. Section 016000 Product Requirements
3. Section 016116 Volatile Organic Compound (VOC) Content Restrictions

B. Related Requirements:

1. Section 013329.02 – Sustainable Design Reporting - LEED v4: General requirements and procedures for compliance with certain prerequisites and credits needed for Project to obtain LEED Gold certification (minimum 60 points) based on USGBC's "LEED v4 for New Construction.

1.2 SUBMITTAL REQUIREMENTS

A. Product Data:

1. Provide product datasheets for all insulation materials, adhesives, and sealants. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
2. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
3. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Insulation products that encounter stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- B. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- C. Insulation must meet VOC Emissions Evaluation requirements as defined in 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS. ASTM C 534, Type I
- E. Fiberglass Insulation:
 - 1. Fiberglass piping insulation: ASTM C 547, Type 1 and 4
 - 2. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers.
 - 3. Vapor Barrier Material: Paper-backed aluminum foil, except as otherwise indicated, strength and permeability rating equivalent to adjoining pipe insulation jacketing.
 - 4. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
 - 5. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
 - 6. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Owens-Corning Fiberglass Corp.
 - c. Keene Corp.
 - d. CertainTeed.
 - e. Johns Manville.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 SEALANTS

A. Joint Sealants:

1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 FACTORY-APPLIED JACKETS

- ### A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.5 FIELD-APPLIED JACKETS

- ### A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- ### B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.

- c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.

4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M; 0.015 inch thick, 1/2 inch wide.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

2.8 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro.
 - f. Zurn Industries, LLC.
2. Description: Manufactured plastic wraps for covering plumbing fixture water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC.
 - c. ProFlo

- d. Plumberex.
- 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.

- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

2. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 3. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 4. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 5. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 6. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 7. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 8. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 9. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 10. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe

- insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FIELD QUALITY CONTROL

- A. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces, unless piping is subject to freezing.
 2. Underground piping conveying unheated fluids.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 1. Insulation shall be one of the following:
 - a. Fiberglass: 1 inch thick.
 - b. Flexible Elastomeric: 1/2 inch thick.
 - c. Insulation thicknesses shall be doubled for piping installed in non-conditioned spaces such as boiler rooms, attics, crawl spaces, tunnels, etc.
- B. Domestic Hot and Recirculated Hot Water:
 1. Insulation shall be one of the following:
 - a. Fiberglass:
 - 1) 1-1/2" and smaller, 1 inch thick
 - 2) Larger than 1-1/2", 1-1/2 inch thick
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Insulation thicknesses shall be doubled for piping installed in non-conditioned spaces such as boiler rooms, attics, crawl spaces, tunnels, etc.

- C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
1. All Pipe Sizes: Insulation shall be one of the following:
 - a. One-piece PVC, with 1/8" thickness, meeting the standards of ASTM E 84-07 with a flame spread/ 450 smoke index per the building code. Surfaces to be soft, smooth, non-absorbent, easy to clean U/V inhibited, antimicrobial, antifungal properties. Insulator shall have a dual fastening system which consists of fusion bonded Velcro fastener strips for full slit enclosure and tamper resistant, smooth, non-abrasive snap-locking fasteners. P-Trap Insulator: Shall have a one-piece design with a universal fit for 1 1/4"-1 1/2" brass or plastic traps, a longer neck area (for longer tailpieces) and a more forgiving girth area (for bulkier plastic DWV Schedule #40 plastic P-Traps w/swivel nut) and shall have drainage at lowest point to prevent condensation and/or leakage build up. Valve and Supply Insulator: Shall have a one-piece design with a universal fit over valve handles and brass, plastic or metal braided supplies and connectors and shall be able to flexcurl to a minimum of 360 degrees with a full slit closure for total compliance. Off-Set Insulator: Shall have a one-piece design with a universal fit and shall fit inside of P-trap insulator tailpiece area.
 - b. Soft, resilient molded vinyl, with 1/8" minimum constant nominal wall thickness with internal ribs, UV resistant, which meets the requirements of ASTM D-635 burning characteristics.
- D. Floor Drains, Traps, and Sanitary Drain Piping within 15 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Fiberglass: 1" thick.
 - b. Flexible Elastomeric: 3/4 inch thick.

End of Section 220719.00

SECTION 221116.00 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data (PD):
 - 1. Provide product datasheets for all products specified under this section.
 - 2. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
 - 3. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 4. Sustainable Design: LEED submittals conforming to requirements listed in Section 013329.02 "Sustainable Design Reporting - LEED v4":
 - a. Provide the following documentation: NSF 61 and NSF 372 certification, lead free, or other documentation as defined in "Sustainable Design Reporting - LEED v4".

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14 and NSF 61.

2.2 COPPER TUBE AND FITTINGS (PIPE SIZE 4" AND SMALLER)

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Coil Tubing: ASTM B 88, Type K water tube, drawn temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- G. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, and are limited to, the following:

- a. Mueller Streamline Co.
 - b. Great Lakes Copper, LTD.
 - c. Cerro Flow Products, LLC.]
- H. Copper Pressure-Seal-Joint Fittings:
 - 1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
 - 2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- I. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, and are limited to, the following:
 - a. Elkhart Products Corporation.
 - b. NIBCO Inc.
 - c. Viega.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.

2.4 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International.
 - e. Matco-Norca.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 - 2. Standard: ASSE 1079.
 - 3. Factory-fabricated, bolted, companion-flange assembly.
 - 4. Pressure Rating: 125 psig minimum at 180 deg F.
 - 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Nonconducting materials for field assembly of companion flanges.
 - 3. Pressure Rating: 150 psig.
 - 4. Gasket: Neoprene or phenolic.
 - 5. Bolt Sleeves: Phenolic or polyethylene.
 - 6. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection Corporation.

- b. Grinnell Mechanical Products; Tyco Fire Products LP.
- c. Matco-Norca.
- d. Precision Plumbing Products, Inc.
- e. Victaulic Company.
- 2. Standard: IAPMO PS 66.
- 3. Electroplated steel nipple complying with ASTM F 1545.
- 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
- 5. End Connections: Male threaded or grooved.
- 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Refer to manufacturers recommended installation instructions prior to installation of any piping system(s).
- C. If a non-plenum rated pipe material is found to pass through a plenum-rated ceiling immediately notify engineer of record prior to installation.
- D. Install copper tubing according to CDA's "Copper Tube Handbook."
- E. Braze all copper fitting connections on underground copper piping installations according to CDA's "Copper Tube Handbook."
- F. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- G. Do not install domestic water piping within 6 inches of gas appliance vents or within 12 inches of any recessed light fixtures.
- H. Do not solder within 18 inches of plastic piping in the same waterline. Make all sweat connections prior to making plastic piping connections.
- I. Ensure no glues, solvents, sealants or chemicals come in contact with PEX tubing without prior permission from the tubing manufacturer.
- J. Protect plastic piping with sleeves where abrasion or cutting may occur.
- K. Use strike protectors where all domestic water piping penetrates a stud or joist and has the potential for being struck with a screw or nail.
- L. Install shutoff valve, strainer, backflow preventer, hose-end drain valve, pressure gage, and test tee with valve inside the building at each domestic water-service entrance.

- M. Install shutoff valve immediately upstream of each dielectric fitting.
- N. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- O. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- P. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- Q. Install piping to permit valve operations and servicing.
- R. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- S. Install piping free of sags and bends.
- T. Install fittings for changes in direction and branch connections. Do not bend piping unless allowable per manufacturers installation instructions.
- U. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- V. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- W. Drawings indicate general arrangement of piping, fittings, and specialties.
- X. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- Y. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- Z. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
 - 1. Solder, flux, pipe, pipe fittings, and fixtures must meet the California AB1953 standard for lead content.
- A. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- B. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- C. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 QUALITY ASSURANCE

Installer Qualifications

Plumbing Contractor shall provide documentation that lists personnel assigned to this project prior to beginning construction who have successfully completed formal CPVC plumbing systems training conducted by an authorized CPVC manufacturer's representative. The Contractor Training documentation shall be specific to the manufacturer of the pipe and fittings. Personnel's training documentation must be current and have been updated within the past two (2) years. (Note: this training does not imply compliance with any local or state contractor certification or licensing laws.)

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples, or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, or nipples.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 220529.00 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 5 feet with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 6 feet with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 9 feet with 1/2-inch rod.
 - 5. NPS 3 to NPS 4: 10 feet with 1/2-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

- 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Immediately drain system(s) following test if ambient air temperature has the possibility of dropping below 32°F.
 - c. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - d. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - e. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - g. Prepare reports for tests and for corrective action required.

3.9 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

End of Section 221116.00

SECTION 221119.00 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data:
 - 1. Provide product datasheets for all products specified under this section.
 - 2. Clearly state full load amps (FLA), voltages and model numbers on all submittals.
 - 3. Sustainable Design: LEED submittals conforming to requirements listed in Section 013329.02 "Sustainable Design Reporting - LEED v4":
 - a. Provide the following documentation: NSF 61 and NSF 372 certification, lead free, or other documentation as defined in "Sustainable Design Reporting - LEED v4".

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated.
- B. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.

- b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; a division of Watts Water Technologies, Inc.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Rough bronze.
- C. [Pressure Vacuum Breakers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1020.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 5 psig maximum, through middle third of flow range.
 - 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Ford Meter Box Company, Inc. (The).
 - f. Honeywell International Inc.
 - g. Legend Valve.
 - h. McDonald, A. Y. Mfg. Co.
 - i. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Body: Bronze with union inlet.

2.3 STRAINERS

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 6 and Larger: 0.10 inch.
6. Drain: Pipe plug.

2.4 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. Oatey.
 - d. Plastic Oddities.
 - e. Symmons Industries, Inc.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
2. Mounting: Recessed.
3. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
4. Water hammer arrestors complying with ASSE 1010.

5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Oatey.
 - c. Plastic Oddities.
2. Mounting: Recessed.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 copper tube outlet.
4. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.5 HOSE BIBBS

A. Hose Bibbs:

1. Where applicable and possible, install all hose bibs 24"-30" above finish floor.
2. Furnish to Owner, with receipt, one valve key for each key operated wall hydrant installed.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Prier Products, Inc.
 - b. Watts Drainage Products.
 - c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - d. Zurn Industries, LLC.
 - e. Chicago Faucets.
 - f. T&S Brass.

2.6 DRAIN VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Watts.
- b. Nibco.
- c. Apollo.

B. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.

7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.7 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Jay R. Smith Mfg. Co.
 - g. Wade.
 - h. Watts Water Technologies
 - i. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld Incorporated.
5. Hyspan Precision Products, Inc.
6. Mercer Gasket & Shim, Inc.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. TOZEN Corporation.
10. Unaflex.Universal Metal Hose; a Hyspan company.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.

3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.9 OUTLET BOXES

A. Icemaker/Refrigerator Outlet Boxes

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Oatey.
 - c. Plastic Oddities.
2. Mounting: Recessed.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 copper tube outlet.
4. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve, and pump.
- C. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs.
- D. Install water-hammer arresters in water piping according to PDI-WH 201.

End of Section 221119.00

SECTION 221316.00 – DRAIN, WASTE, AND VENT (DWV) PIPING

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

1. Provide product datasheets for all products specified under this section.
2. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
3. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. This specification is intended to include, but not limited to, sanitary, storm, and vent systems as they apply to the drain, waste, and vent piping products.
- B. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 1. DWV Piping: 10-foot head of water.
 2. Force-Main Piping: 125 psig.
- C. Plastics Piping Systems Components and Related Materials shall comply with NSF/ANSI 14, for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. Cast-iron DWV pipe and fittings shall be certified NSF and shall be marked with the trademark of the Cast Iron Soil Pipe Institute.

2.2 PVC PIPE AND FITTINGS

- A. Solid-Wall, Schedule 40 PVC Pipe: ASTM D 2665 and ASTM D 1785 DWV pipe.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 2665, DWV patterns and to fit Schedule 40 pipe.
 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Adhesive Primer: ASTM F 656.
 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.
- E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Charlotte Pipe and Foundry Corporation.
 2. North American Pipe Corporation.
 3. Spears Manufacturing Company.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888, ASME B16.12, and CISPI 301.
- B. [Standard Hubless-Piping Couplings:
 1. Standards: ASTM C 1277 and CISPI 310.
 2. Description: Stainless-steel corrugated shield with (4) stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Charlotte Pipe and Foundry Corporation.
 2. AB&I Foundry/ McWane, Inc.
 3. Tyler Pipe/ McWane, Inc.
 4. ANACO-Husky.
 5. Fernco Inc.
 6. MIFAB, inc.

2.4 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 3. Shielded, Nonpressure Transition Couplings:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ANACO-Husky.
 - 2) Fernco Inc.
 - 3) MIFAB, inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Dielectric Fittings:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Spears Manufacturing Company.
 - 2) Watts Water Technologies, Inc.
 - 3) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Spears Manufacturing Company.
 - 2) Watts Water Technologies, Inc.
 - 3) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
 4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - b. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Grinnell Mechanical Products.
 - 2) Matco-Norca, Inc.
 - 3) Precision Plumbing Products, Inc.
- b. Description:
 - 1) Standard: IAPMO PS 66
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 300 psig at 225 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

- A. Where new sanitary and/or storm sewers are required to be connected to existing sewer(s), it is the contractor's responsibility to verify the location, size, invert elevation, and condition of sewer. To avoid a misconnection of system types, the contractor shall verify that the existing sewer is indeed a sanitary and/or storm sewer before any work is done. Provide all necessary camera scoping and dye testing to complete proper field investigations. If there is any discrepancies between the existing sewer(s) shown on plan from actual field conditions, or condition(s) of the existing sewer(s) is not viable for re-use, or any other condition that would not allow the proper functioning of the new sewer, the contractor shall notify the engineer in writing immediately via RFI and wait for direction before proceeding.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Slope piping according to local codes.
- F. Install piping free of sags and bends.
- G. Install piping to allow application of insulation.

- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Collect vent piping where practical so roof will be penetrated a minimum number of times. Vent sizes and heights above roof shall be per the Plumbing Code in force. Vents penetrating roofs shall be flashed with 4 lb. sheet lead. Vents shall not be terminated within ten feet of any outside air intakes, windows, or door openings.
- K. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- L. Install underground PVC piping according to ASTM D 2321.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- N. PVC piping shall not be installed in plenum spaces. Coordinate plenum ceiling locations with engineer of record and HVAC contractor prior to bid submission.

3.3 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
 - 1. Cast iron coupling for joining hubless cast iron pipe shall consist of neoprene gasket produced and labeled as ASTM C 564, cast iron clamps produced and labeled as ASTM A 48 and stainless steel bolts and nuts produced and labeled as ANSI B18.2.1 and ANSI B18.2.2. Neoprene gaskets shall be produced and labeled as ASTM C 564-70.
- B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Solvent cements shall conform to ASTM D 2665.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.
 - 3. Primers conforming to ASTM F 656 shall be applied to all joint surfaces.

4. Solvent cement conforming to ASTM D 2564 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D 2855.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 1. Install transition couplings at joints of piping with small differences in OD's.
 2. In DWV piping: 4-band, shielded, non-pressure transition couplings.
- B. Dielectric Fittings:
 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, or nipples.
 4. Dielectric Fittings for NPS 6 and Larger: Use dielectric flange kits.

3.5 CONNECTIONS

- A. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- C. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- D. Make connections according to the following unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.

3.7 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 PIPING SCHEDULE

- A. Aboveground, DWV piping shall be the following:
 1. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
- B. Underground DWV piping shall be the following:

1. Solid-wall, Schedule 40 PVC pipe, PVC socket fittings, and solvent-cemented joints.

End of Section 221316.00

SECTION 221319.00 – DRAIN, WASTE AND VENT PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data (PD):
1. Provide product datasheets for all products specified under this section.
 2. Clearly state model numbers on all submittals.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Cleanouts:
1. Cast-iron Exposed Cleanouts:
 - a. Standard: ASME A112.36.2M for cast iron cleanout.
 - b. Provide product equal to Zurn ZN1400 cleanout with Dura-Coated cast iron body with gas and watertight ABS tapered thread plug.
 - c. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - 2) Watts Drainage Products Inc.
 - 3) Zurn Industries, LLC.
 2. PVC Floor Cleanouts:
 - a. Provide product equal to Zurn EZC 6" top, adjustable PVC floor cleanout, solvent weld body, with gas and water tight ABS tapered plug and top assembly, round light duty scoriated cover in nickel bronze.
 - b. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Oatey.
 - 2) Sioux Chief Manufacturing Company, Inc.
 - 3) Zurn Industries, LLC.]
 3. Provide carpet markers on all floor cleanouts installed below carpeted floors.
- B. Wall Cleanouts:
1. Cast-iron Wall Cleanouts:
 - a. Standard: ASME A112.36.2M. Include wall access.
 - b. Provide product equal to Zurn Z1445 cleanout body and plug complete with square wall access panel and frame equal to Zurn Z1460, smooth, stainless steel panel secured to frame, set flush to finish wall plane, complete with securing lugs.

- c. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - 2) Watts Drainage Products Inc.
 - 3) Zurn Industries, LLC.

2.2 FLOOR DRAINS

- A. Cast-iron Floor Drains:
 - 1. Standard: ASME A112.6.3.
 - 2. Refer to schedule on drawings for manufacturer and model number(s). If a load rating is not scheduled provide a heavy duty 'Class E' load rating.
 - 3. All floor drains located in rooms with tile floors shall be provided with manufacturer's standard square grate.
 - 4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Watts Drainage Products Inc.
 - c. Zurn Industries, LLC.
- B. PVC Floor Drains:
 - 1. Standard: ASME A112.6.3.
 - 2. Refer to schedule on drawings for manufacturer and model number(s). If a load rating is not scheduled provide a heavy duty 'Class E' load rating.
 - 3. All floor drains located in rooms with tile floors shall be provided with manufacturer's standard square grate.
 - 4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Oatey.
 - 2) Sioux Chief Manufacturing Company, Inc.
 - 3) Zurn Industries, LLC.

2.3 ADDITIONAL REQUIREMENTS

- A. If not expressly specified, the following drainage specialty products shall be equipped with and include, but are not limited to:
 - 1. Floor Drains:
 - a. Membrane clamp.
 - b. Adjustable collar with weep holes.
 - c. Structural deck drain stabilizer.
 - d. Trap primer connection.
 - e. Heavy-duty slotted grate.
 - 2. Primary and Secondary Roof Drains:
 - a. Membrane clamp.
 - b. Structural deck drain stabilizer.

- c. Underdeck clamp.
- d. 2-inch high static extension.
- e. 2-inch high external water dam.
- f. Roof sump receiver.
- g. Roof deck plate.

2.4 MECHANICAL TRAP SEALS

- A. Provide an elastomeric, mechanical trap guard device which utilizes a normally closed seal to prevent evaporation of the trap seal and also prevents sewer gases from backing up to habitable areas.

2.5 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
 - c. ProSet Systems Inc.
 - d. Josam Company; Josam Div.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
- C. Frost-Resistant Vent Caps: Install frost-resistant vent caps on each vent pipe passing through roof, and elsewhere where indicated. Maintain 1" clearance between vent pipe and roof substrate. Coordinate vent penetrations with HVAC equipment. Maintain a minimum of 10 feet clearance from all outside air intakes, relief louvers, exhaust louvers and any other opening to the inside which could receive sewer gas infiltration.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M.
 - b. Hilti, North America.
 - c. ProSet Systems Inc.
 - 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.

3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. No-hub Cast Iron Soil Pipe Fitting Restraints

1. Description: CISPI Designation 301-12, large diameter no-hub cast iron fittings, over 4 inches (102 mm) in size, shall be provided with supplemental support to minimize the risk of joints separation under high thrust conditions. Auxiliary restraint products used shall be manufactured assemblies with thrust pressure rating adequate for the specific installation. Field devised methods and materials shall not be used to accomplish this application solution.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. HOLDRITE
 - b. EBAA Iron, Inc.
 - c. Romac Industries, inc.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.8 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Applications: 12 oz./sq. ft..
 - 2. Vent Pipe Flashing: 8 oz./sq. ft..
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 2. Install expansion joints, if indicated, in roof drain outlets.
 3. Position roof drains for easy access and maintenance.
- F. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

3.2 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.

- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

End of Section 221319.00

DIVISION 22 - PLUMBING

SECTION 221550 - MEDICAL GAS PIPING SYSTEMS

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall provide all equipment and specialties complete with trim required and connect in a manner conforming to the NFPA and all other applicable codes.
- 1.3 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc., as required for lay-out of his rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- 1.4 All equipment and specialties shall be new unless otherwise indicated or specified. They shall also be of equivalent quality, dimensions, materials, etc., as those specified.
- 1.5 All equipment and specialties shall be installed as recommended by the manufacturer.
- 1.6 All equipment and specialties shall be installed in a neat and workmanlike manner. Unacceptable workmanship shall be removed and replaced at the installing Contractor's cost.
- 1.7 Refer to applicable Electrical sections for control wiring and power wiring.

PART 2 – DESCRIPTION OF WORK:

- 2.1 Extent of medical gas piping system work is indicated on the drawings and by requirements of this section.
- 2.2 NFPA COMPLIANCE: Comply with requirements of NFPA Standard 99 Gas and Vacuum Systems. All portions of each system shall be listed by and bear the seal of UL, Inc., where a standard has been established for such.
- 2.3 COMPLY WITH ANSI/AWS A5.8 - Specifications for Brazing Filled Metal regarding pipe joint make-up.
- 2.4 CENTRAL MEDICAL GAS: Compressed Air; complete, ready for operation, including all necessary piping, fittings, valves, cabinets, station outlets and inlets, equipment connections, rough-ins, ceiling services, gauges, alarms, nitrogen control panels, air compressors, and all necessary parts, accessories, connections and equipment.
- 2.5 QUALITY ASSURANCE:
 - 2.5.1 Materials and Installation: In accordance with NFPA 99, and as specified.
 - 2.5.2 Equipment Installer: Show technical qualification and previous experience in installing medical gas equipment on three similar projects.
 - 2.5.3 Equipment Supplier: Show evidence of equivalent product installed at three installations similar to this project that has been in satisfactory and efficient operation for three years.
 - 2.5.4 Independent Medical Gas System Testing Organization:
 - 2.5.4.1 Testing agency that is financially independent of medical gas equipment manufacturer and supplier.

- 2.5.4.2 Provide names of three projects where testing of medical gases and systems has been performed by the testing agency. Include the name of the project, names of such persons at that project who supervised the work for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification.
- 2.5.4.3 The medical gas testing agency shall review all contract documents and provide any comments prior to any installation of these systems. The purpose of this review process is to eliminate any potential issues that could arise during the certification process. All comments shall be forwarded to the Engineer upon receipt for field clarification. Failure to comply with this requirement will cause any additional costs to be incurred by the installing contractor if any issues arise after installation due to the testing agency's findings.
- 2.5.4.4 Submit the testing agency's detailed procedure which will be followed in the testing of this project. Include details of the testing sequences, procedures for cross connection, tests, outlet function tests, ceiling column function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.
- 2.5.4.5 Certification: Provide documentation upon completion of the testing to include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this section.

PART 3 – MEDICAL GAS PIPING:

- 3.1 GENERAL: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated on drawings. Provide materials and products complying with the latest NFPA 99. Provide fittings of materials which match pipe materials used in medical gas piping systems including equipment connection.
- 3.1.1 Piping shall be hard-drawn seamless medical gas tube, Type K or L (ASTM B819), and bear one of the following markings: MED. Mains and branches in piping systems shall be not less than ½ in. nominal size. Runouts to area alarm panels shall be permitted to be 1/4 in. nominal size.
- 3.1.2 Brazing Alloy: Provide brazing that complies with the latest NFPA 99 Gas and Vacuum Systems.
- 3.1.3 Threaded Joints: Provide threaded joints that comply with the latest NFPA 99 Gas and Vacuum Systems.
- 3.1.4 Identification: The gas content of medical gas piping systems shall be readily identifiable by appropriate labeling with the name of the gas contained. Such labeling shall be by the means of metal tags, stenciling, stamping or with adhesive markers in a manner that is not readily removable. Labeling shall appear on the piping at intervals of not more than 20 ft (6 m) and at least once in each room and each story traversed by the piping system. Identify piping as follows:
- | 3.1.4.1 | <u>SYSTEM</u> | <u>IDENTIFICATION COLOR</u> | <u>PIPE COLOR</u> |
|---------|---------------|----------------------------------|-------------------|
| | MED AIR | Black Or White Letters On Yellow | Yellow |
- 3.1.5 All underground piping from the bulk oxygen tank to the building shall be installed in a PVC sleeve. Coordinate size of piping with oxygen service size.

PART 4 – MEDICAL GAS SYSTEM COMPONENTS:

- 4.1 GENERAL: Furnish and install per latest NFPA 99 requirements a complete oxygen, vacuum, medical air, nitrous oxide, nitrogen, vacuum system, carbon dioxide systems, etc., including, but not limited to, the following list:
- 4.2 PRESSURE GAUGES:
- 4.2.1 For Line Pressure Use Adjacent to Source Equipment: ANSI B40.1, pressure gauge, single, size 4-1/2, for compressed air, nitrogen and oxygen, accurate to within two percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on white background, or white on a black background. Gauge shall be cleaned for oxygen use, labeled for appropriate service, and marked "USE NO OIL." Install with gaugecock.
- 4.2.2 For All Services Downstream of Main Shutoff Valve: Manufactured expressly for oxygen use but labeled for appropriate service and marked "USE NO OIL," 1-1/2 inch diameter gauge with dial range 1-100 psig for oxygen, nitrous oxide and air, and 1-300 psig for nitrogen service.
- 4.3 VALVES:
- 4.3.1 All valves shall comply with the latest NFPA 99 Gas and Vacuum Systems.
- 4.3.2 Ball valves to be Fed. Spec. WW-V-35, Type II, Class A, Style 1, with brazed connections. Three-piece, Buna-N or teflon seat seals, full flow, 300 psig minimum working pressure, with locking type handle.
- 4.3.3 Check valves to be brass body, self-aligning, spring loaded ball type check mating with teflon cone seat.
- 4.3.4 Cabinets shall be flush mounted, not lighter than 18 gauge steel or 14 gauge extruded aluminum, rigidly assembled, of adequate size to accommodate valve(s) and fittings. Punch or drill sides to receive tubing. Provide anchors to secure cabinets to wall construction. Seal openings in cabinet to be substantially dust tight. Locate bottom of cabinet approximately four-feet six-inches above floor unless otherwise indicated.
- 4.3.5 Mount metal or plastic identification plate in cabinets. Identification plate must be clearly visible at all times. Provide inscriptions on plate to read in substance: "THESE VALVES CONTROL SUPPLIES TO ROOMS _____."
- 4.3.6 Cover Plate shall be fabricated from 18 gauge sheet metal with satin chromed finish, extruded anodized aluminum, or 22 gauge stainless steel. Provide cover window of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. Permanently paint or stencil on window: "FOR EMERGENCY ONLY, SHUT-OFF VALVES FOR PIPED GASES," or equivalent wording. Configure such that it is not possible to install window with any valve in the closed position.
- 4.4 AIR COMPRESSOR SYSTEMS:
- 4.4.1 Medical air compressors provide compressed air for patient use only. All components shall be provided by and the responsibility of one manufacturer and shall be factory packaged (prewired and prepiped) on a steel base, or tank mounted. Completed system installation shall provide medical air quality equal to or better than the quality specified under ANALYSIS, TESTS.
- 4.4.2 Compressors: Provide quality of air equal to or better than the quality of the intake air, without the use of purification equipment. Multiplex such that design load is provided with the largest single unit out of service. Design piping, accessories and controls to withstand 150 psig. Provide each compressor with automatic check valves as required for proper operation and the prevention of loss of pressure through the compressor. Provide manual shut-off valve downstream of the check valve for service to check valve and compressor without total system shutdown.

- 4.4.2.1 Reciprocating Type: Capable of delivering a minimum pressure of 125 psig, without oil lubrication, with bearings packed with non-petroleum based product and sealed for lifetime lubrication; piston compression and guide rings and piston skirts warranted for minimum 8,000 operating hours; rated for continuous dry, 24 hours per day, seven days per week.
- 4.4.2.2 Liquid Ring Type: Capable of delivering a minimum pressure of 80 psig, using potable water as seal fluid, positive displacement, non-pulsating. Liquid ring systems using 90 percent or greater recirculating are NOT ALLOWED.
- 4.4.2.3 Motor and Starter: Open dripproof construction, continuous duty rated with service factor of 1.15 or greater; sufficient capacity to drive compressors without exceeding the nameplate rating of the motor. Provide each motor with automatic, fully enclosed, magnetic starter or type specified in other specification sections. Refer to the schedule on the drawings for HP and voltage requirements.
- 4.4.2.4 Controls: All controls shall be housed in a NEMA Type 12 enclosure and contain disconnect switch, motor starters, alternators, transformers, indicator lights and all required operating controls to be NFPA compliant. Panel to be UL listed.
- 4.4.2.5 Receiver Tank: Welded steel, galvanized, in compliance with ASME Section VIII, 125 psig working pressure stamped and certified. Equip with safety relief valve set at 120 psig, float type automatic drain, sight glass and pressure gauge. Provide receiver of sufficient capacity to ensure practical on./off operation of compressors.
- 4.4.2.6 Air Silencer: Finned dry type inlet filter/muffler, enclosed in a housing allowing easy removal of the element for inspection of replacement, with a nominal retention of 10 microns or less and muffling by a series of silencer tubes. Provide filter of sufficient size to minimize back pressure.
- 4.4.2.7 Air Filters: Provide duplex outlet filter sets, piped in parallel and provided with valves to bypass each filter set for element replacement without system shutdown. Provide prefilters, final filters and odor/taste removal filter.
- 4.4.2.8 Pressure Reducing Regulators: Provide duplexed in parallel, valved for maintenance shutdown without service interruption. Brass or bronze body and trim, reduced pressure rang 0-125 psig adjustable, piston type, pilot operated, relieving. Delivered pressure shall vary not more than 1 psig for each 10 psig variation in inlet pressure.
- 4.4.2.9 Dew Point Monitor: With digital or gauge type display, locate sensor in the pipeline downstream of regulators for continuous monitoring at line pressure. Install with valved, normally closed by-pass to allow disconnection without system shutdown. Provide local non-cancellable visual and cancellable audible alarm and a signal to the master alarm panels to operate when pressure dew point rises above 39 degrees F at 55 psig.
- 4.4.2.10 Air Dryer: Duplexed, each sized for 100% of design load, self-contained, refrigerated type, with counter current heat exchanger, hermetically sealed refrigeration system, moisture separator with automatic drain and all internal wiring and plumbing. House unit in factory standard corrosion resistant cabinet with access doors or panels as required for ease of service and maintenance. Dryer shall be capable of providing 35 degrees F (2 degrees C) pressure dewpoint at 100 psig inlet pressure, 100 degrees F inlet temperature and 100 degrees F inlet dewpoint under full load conditions and be properly sized to produce 35 degrees F or better pressure dewpoint under full load at site conditions.
- 4.4.2.11 All medical air compressors shall be manufactured by Medeas, Puritan Bennett, Nash or equivalent.

PART 6 – PURGING:

- 6.1 After all medical gas piping systems have been tested, the source of the test gas shall be disconnected and the proper gas source of supply connected to each respective system. Following this connection and

pressurization, all outlets shall be opened in a progressive order, starting nearest the source and completing the process of purge flushing at the outlet farthest from the source.

- 6.2 Purge gas shall be allowed to impinge upon a white cloth material at a minimum flow rate of 100 liters per minute until no evidence of discoloration is evident and the test gas used during the previous tests has been removed from the piping systems.

PART 7 – ANALYSIS:

- 7.1 After completing the purge flushing of the piping in accordance with the latest NFPA 99, the flow of gas from each station outlet for oxygen, mixed gases containing oxygen and medical compressed air shall be tested with an oxygen analyzer to confirm the presence of the desired percentage of oxygen. Testing of outlets for other gases to confirm the presence of the designated gas is also required.
- 7.2 Where mixtures are piped that involve a low concentration of one component, such as 95% oxygen and 5% carbon dioxide, an analyzer must be used having sufficient accuracy to properly indicate the mixture. This, in some cases, may require an analyzer specific to each component.
- 7.3 The test specified in the latest NFPA 99, shall be conducted on the downstream portions of the medical gas piping system whenever a system is breached and whenever modifications are made or maintenance performed in anesthetizing locations or vital life support or critical area.
- 7.4 The only test required when the oxygen (pure or mixed) or medical compressed air portion of an existing piped medical gas system is repaired is an analysis test to assure that no cross-connection of gases has been created. This may seem unnecessary when replacing a broken outlet or zone valve, but it is very important to document that the correct gas is flowing out of a labeled outlet. There can be no compromises in patient safety with respect to gases that will be inhaled by patients.
- 7.5 Prior to the connection of any work to the systems, all tests shall be successfully performed. After connection to the systems and before use for patient care, the tests in the above sections shall be successfully completed.
- 7.6 The final connection shall be leak tested with the source gas at the normal operating pressures. This pressure shall be maintained until each joint has been examined for leakage by means of soapy water or other equally effective means of leak detection safe for use with oxygen.

PART 8 – INSTALLATION AND TESTING OF MEDICAL GAS SYSTEM:

- 8.1 In accordance with the latest NFPA 99, before installation, all piping, valves, fittings and other components for all nonflammable medical gas systems shall be thoroughly cleaned of oil, grease and other readily oxidizable materials as is for oxygen service. After cleaning, particular care shall be exercised in the storage and handling of such material. Such material shall be temporarily capped or plugged to prevent recontamination before final assembly. Just prior to final assembly, such material shall be examined internally for contamination and shall be recleaned if necessary.
- 8.2 Piping, valves, fittings and other components that have been especially prepared shall have been cleaned in accordance with the provisions of CGA Pamphlet G-4.1, Cleaning Equipment for Oxygen Service. Such material shall be delivered capped or plugged and shall be inspected prior to final assembly as required in the latest NFPA 99. If necessary, recleaning shall be done in accordance with NFPA 99.
- 8.3 Piping, valves, fittings and other components prepared at the job site shall be cleaned by washing in a hot alkaline cleaner-water solution, such as sodium carbonate or trisodium phosphate (proportion of one pound to three gallons of water). Scrubbing shall be employed where necessary to ensure complete cleaning. After washing, the materials shall be thoroughly rinsed in clean, hot water.
- 8.4 Comply with other specification section for exposed piping and sleeves.

- 8.5 Keep open ends of tube capped or plugged at all times. Wash and rinse unplugged, partially completed piping system in accordance with Article, Cleaning of Piping, Valves and Fittings.
- 8.6 Cut piping square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. Ream tube to remove burrs, being careful not to expand tube and so no chips of copper remain in the tube. Work into place without springing or forcing. Bottom tube in socket so there are no gaps between tube and fitting. Exercise care in handling equipment and tools used in cutting or remaining of tube to prevent oil or grease being introduced into tubing. Where contamination has occurred, rewash affected items in accordance with Article, Cleaning of Piping, Valves and Fittings.
- 8.7 SPACING OF HANGERS: Shall comply with the latest NFPA 99, but shall in no case be greater than 10 feet.
- 8.8 Rigidly support valves and other equipment to prevent strain on tube or joints.
- 8.9 Take care not to anneal copper tube while brazing. Braze only while purging the interior tube with nitrogen, minimum U.S.P. or Grade B as specified in CGA G-10.1. All brazed joints in the piping shall be made up using brazing filler allows that bond with the base metals being brazed and that comply with Specification for Brazing Filler Metal, ANSI/AWS A5.8 and the latest NFPA 99.
- 8.10 Install pressure and vacuum switches to be easily accessed and provide access panel where installed above plaster ceiling.
- 8.11 After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency perform final tests complying with the latest NFPA 99.

PART 9 – CERTIFICATION AND TESTS:

- 9.1 Cross connection certification shall be the responsibility of the Contractor and shall be as follows:
- 9.2 Cross-connection testing and certification of the medical-gas system shall be performed by medical gas testing agency.
- 9.2.1 Medical-gas system shall be tested in accordance with the latest NFPA 99.
- 9.2.2 In addition to cross-connection testing, this specification shall require the medical gas testing agency to test each individual pipeline system component for performance to design specifications and the Contractor make any necessary adjustments to ensure a complete and working system.
- 9.2.3 In the event the cross-connection test indicates contaminated or cross connected medical gas systems, it shall be the responsibility of the Contractor to correct the problems at no additional cost to the Owner. This procedure shall be repeated until the cross-connection test proves positive and is hence certified.
- 9.3 TESTS:
- 9.3.1 Initial Tests: Blowdown, and high and low pressure leakage tests as required by the latest NFPA 99, with documentation.
- 9.3.2 Medical Gas Testing Agency Shall Perform the Following:
- Perform and document all cross connection tests, labeling verification, supply system operation and valve and alarm operation tests as required by and in accordance with NFPA 99 and the procedures set for in prequalification documentation.
 - Verify that the systems, as installed, meet or exceed the requirements of NFPA 99 and this specification and that the systems operate as required.

- Piping Purge Test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 3.5 cubic feet (100 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 lpm). Filter shall show no discoloration and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.
- Piping Purity Test: For each positive pressure system, verify purity of piping system. Test each zone at the most remote outlet for dew point, carbon monoxide, total hydrocarbons (as methane) and halogenated hydrocarbons and compare source gas. The two test must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Perform test with the use of an inert gas.
- Outlet and Inlet Flow Test:
 - Test all outlets for flow. Perform test with the use of an inert gas.
 - Oxygen, nitrous oxide and air outlets must deliver 3.5 scfm with a pressure drop of no more than 5 psig and static pressure of 50 psig.
 - Nitrogen outlets must deliver 5.0 scfm with a pressure drop of no more than 5 psig and static pressure of 160 psig. High pressure nitrogen outlet must deliver same at 250 psig static pressure.
 - Vacuum inlets must draw no less than 3.0 scfm with adjacent inlet flowing, at a dynamic inlet pressure of 12-inches Hg and a static vacuum of 15-inches Hg.
 - Anesthesia evacuation inlets must draw no less than 1.0 scfm at a dynamic inlet pressure of 12-inches Hg and a static vacuum of 15-inches Hg.
 - Source Contamination Test: Analyze each pressure gas source for concentration of contaminants, by volume. Take samples for air system test at the intake and at a point immediately downstream of the final filter outlet. The compared tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Allowable concentrations are below:
 - Dew Point: Air - Minus 18 degrees C atmospheric
 All Others - Minus 45 degrees C atmospheric
 - Carbon Monoxide: 10 ppm
 - Carbon Dioxide: Air - 1000 ppm
 All Others - 300 ppm
 - Gaseous Hydrocarbons: Air - 5 ppm (as methane)
 - Halogenated Hydrocarbons: Air - 2 ppm
 - Analysis Test:
 - Analyze each pressure gas source and outlet for concentration of gas, by volume.
 - Make analysis with instruments designed to measure the specific gas dispensed.
 - Allowable concentrations are within the following:
 - ✓ Medical Air - 19.5% to 23.5% Oxygen
 - Maximum Allowable Variation: Between comparative test results required as follows:
 - Dew Point - 2 degrees C
 - Carbon Monoxide - 2 ppm
 - Total Hydrocarbons as methane - 1 ppm
 - Halogenated Hydrocarbons - 2 ppm

END OF SECTION.

SECTION 223001.00 - THERMOSTATIC MIXING VALVES

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data:
 - 1. Provide product datasheets for all products specified under this section.
 - 2. Clearly state voltages, if applicable, and all model numbers on all submittals.
 - 3. Sustainable Design: LEED submittals conforming to requirements listed in Section 013329.02 "Sustainable Design Reporting - LEED v4":
 - a. Provide the following documentation: NSF 61 and NSF 372 certification, lead free, or other documentation as defined in "Sustainable Design Reporting - LEED v4".

PART 2 - PRODUCTS

2.1 MASTER THERMOSTATIC MIXING VALVE AT WATER HEATER

- A. Master thermostatic mixing valve shall be a single valve and rated for a minimum flow of equal to 0.5 gpm – 100 gpm @ 20 psi maximum pressure drop. Valve shall be complete, fully assembled water tempering control system, includes one thermostatic mixing valve capable of maintaining water temperature to within 15°F above set point within the range of 40°F to 160°F. Valve to compensate for temperature fluctuations due to inlet temperature or pressure changes. Equipped with triple-duty check stops and an advanced, paraffin based thermal actuator. Provides precise control in accordance with ASSE 1017 and CSA B125. Control system will be mounted on a heavy-duty welded strut with corrosion resistance coating, and factory tested as a complete unit. Includes an internal by-pass loop for fast and easy set-up along with GFCI protection. Includes a job specific circulator and combination temperature/pressure gauges. Provide with circuit setter. Hot water outlet temperature shall be set to 120 degrees.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering valves which may be incorporated in the work include, but are not limited to, the following:
 - 1. Acorn
 - 2. Powers
 - 3. Leonard
 - 4. Bradley

2.2 POINT-OF-USE THERMOSTATIC MIXING VALVES FOR SINKS AND LAVATORIES

- A. Tempered water shall be delivered to all public hand-washing facilities including, but not limited to sinks and lavatories through an approved water-temperature limiting device that conforms to ASSE 1070.
- B. Set outlet temperature of thermostatic mixing valve to 105 degrees F.

- C. Route tempered water to hot water side of sink and/or lavatory.
- D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering valves which may be incorporated in the work include, but are not limited to, the following:
 - 1. Acorn
 - 2. Powers
 - 3. Leonard
 - 4. Bradley

PART 3 - EXECUTION

3.1 THERMOSTATIC MIXING VALVE INSTALLATION

- A. Provide all accessories in accordance with manufacturer's installation instructions.
- B. Provide hot and cold water piping to each master mixing valve with shutoff valves.
- C. Provide temperature gauges on inlet and outlet piping from each master mixing valve.
- D. Provide check valves on the hot and cold-water inlet supply piping to each thermostatic mixing valve regardless if thermostatic mixing valve contains integral check valves.

End of Section 223001.00

SECTION 223300.00 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data:
 - 1. Provide product datasheets for all products specified under this section.
 - 2. Clearly state all full load amps (FLA), voltages and model numbers on all submittals.
 - 3. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 4. Wiring Diagrams: For power, signal, and control wiring.

1.2 PERFORMANCE REQUIREMENTS

1.3 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AO Smith.
 - b. Bradford White Corporation.
 - c. Lochinvar Corporation.
 - d. State Industries.
 - 2. Standard: UL 1453.

2.2 ELECTRIC, INSTANTANEOUS, DOMESTIC WATER HEATERS

- A. Electric, Instantaneous, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AO Smith.
 - b. Chronomite, Inc.
 - c. Eemax, Inc.
 - d. Niagara Industries, Inc.
 - e. Stiebel-Eltron Worldwide
2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
3. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
4. Connections: ASME B1.20.1 pipe thread.
 - a. Pressure Rating: 150 psig
 - b. Heating Element: Resistance heating system.
 - c. Temperature Control: Thermostat.
 - d. Safety Control: High-temperature-limit cutoff device or system.
 - e. Jacket: Aluminum or steel with enameled finish or plastic.
5. Support: Bracket for wall mounting.
6. Capacity and Characteristics: As indicated on the drawings.

2.3 DOMESTIC WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMTROL Inc.
 - b. Flexcon Industries.
 - c. State Industries.
 - d. Watts Water Technologies Co.
2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base.
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.
- B. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Anchor domestic-water heaters to substrate.
- C. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards.
- D. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- E. Provide combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

- F. Provide water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- G. Provide temperature gauges on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Set expansion tank pre-charge tanks with air prior to filling the domestic water system.

3.2 CONNECTIONS

- A. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

End of Section 223300.00

SECTION 224000.00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data:
 - 1. Provide product datasheets for all products specified under this section.
 - 2. Clearly state full load amps (FLA), voltages (where applicable) and model numbers on all submittals.
 - 3. Include material descriptions, dimensions of individual components and profiles, and finishes for fixtures.
 - 4. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 5. Include diagrams for power, signal, and control wiring of automatic fixtures where applicable.
 - 6. Fixtures provided shall meet the flow rates of those specified in order to meet the water-use reduction goals desired.
 - 7. Provide product Data for Water Efficiency Prerequisites and Credits as required: Documentation indicating flow and water consumption requirements.

1.2 EXTRA MATERIALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents as indicated below:
 - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.
 - 2. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed but not less than one.
 - 3. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed but not less than one.
 - 4. Filter Cartridges for Drinking Fountains and Water Coolers: Equal to 20 percent of quantity installed for each type and size indicated, but no fewer than 1 of each.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

- A. Water Closets:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Zurn Industries, LLC; Commercial Brass and Fixtures.

- d. Toto USA, Inc.

2.2 URINALS

A. Wall-Hung and Floor-Set Urinals

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Zurn Industries, LLC; Commercial Brass and Fixtures.
 - d. Toto USA, Inc.

2.3 FLUSHOMETER VALVES

A. Flushometer Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Sloan Valve Company.
 - d. Zurn Industries, LLC; Commercial Brass and Fixtures.
 - e. Toto USA, Inc.

2.4 TOILET SEATS

A. Toilet Seats:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard America.
 - b. Bemis Manufacturing Company.
 - c. Centoco Manufacturing Corporation.
 - d. Church Seats.
 - e. Kohler Co.
 - f. Olsonite Seat Co.
 - g. Toto USA, Inc.
 - h. Zurn Industries, LLC; Commercial Brass and Fixtures.

2.5 LAVATORIES

A. Lavatories:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard America.

- b. Kohler Co.
- c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2.6 STAINLESS STEEL SINKS

A. Stainless Steel Sinks:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acorn Engineering Co.
 - b. Advance Tabco.
 - c. Amtekco Industries, Inc.
 - d. Elkay Manufacturing Co.
 - e. Just Manufacturing.
 - f. Eagle Group; Foodservice Equipment Division.

2.7 MOP SINKS

A. Service Sinks:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Kohler Co.
 - b. Fiat Products.
 - c. Elkay Manufacturing Co.
 - d. Just Manufacturing.
 - e. Advance Tabco.
 - f. Mustee, E. L. & Sons, Inc.

2.8 FAUCETS

A. Lavatory, Sink, Bathtub, and Shower Faucets:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard America.
 - b. Bradley Corporation.
 - c. Chicago Faucet Company.
 - d. Delta Faucet Company.
 - e. Elkay Manufacturing Co.
 - f. Just Manufacturing.
 - g. Kohler Co.
 - h. Speakman Company.
 - i. T & S Brass and Bronze Works, Inc.
 - j. Zurn Industries, LLC; Commercial Brass and Fixtures.
 - k. Symmons Industries, Inc.
 - l. Powers, Watts Water Technologies Co.
 - m. Sloan Valve Company.

2.9 DRINKING FOUNTAINS AND WATER COOLERS

A. Drinking Fountains and Water Coolers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elkay Manufacturing Co.
 - b. Murdock; a division of Acorn Engineering Company.
 - c. Oasis International.
 - d. Haws Corporation.
 - e. Halsey Taylor.

2.10 PLUMBING FIXTURE TRANSFORMER

A. Plumbing Fixture Transformer:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sloan.
 - b. Bradley Corporation.
 - c. Gerber Plumbing Fixtures LLC.
 - d. Moen Incorporated.

2.11 SUPPLY FITTINGS

- A. Standard: ASME A112.18.1/CSA B125.1.
- B. Supply Piping: Braided Stainless-Steel supplies, Chrome-plated-brass pipe, or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- C. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- D. Risers:
 1. NPS 1/2.
 2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces, chrome-plated, soft-copper flexible tube, ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.12 FIXTURE CARRIERS

A. Fixture Carriers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam manufacturing Company.
 - b. MIFAB, Inc.

- c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
- d. Tyler Pipe; Wade Div.
- e. Watts Drainage Products Inc.
- f. Zurn Plumbing Products Group; Specification Drainage Operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Fixture Installation:
 - 1. Install fixtures level and plumb according to manufacturer's rough-in drawings.
- B. Traps:
 - 1. Install traps on fixture outlets.
 - a. Exception: Omit trap on fixtures with integral traps.
 - b. Exception: Omit trap on indirect wastes unless otherwise indicated.
- C. Water Closet Installation:
 - 1. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
 - 2. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
 - 3. Use carrier supports with waste-fitting assembly and seal.
 - 4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
- D. Urinal Installation:
 - 1. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
 - 2. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
 - 3. Install supports, affixed to building substrate, for wall-hung urinals.
 - 4. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
 - 5. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
- E. Flushometer-Valve Installation:
 - 1. Install flushometer-valve, water-supply fitting on each supply to each flushometer fixture.
 - 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 - 3. Install lever-handle flushometer valves for accessible fixtures with handle mounted on open side of fixture.
 - 4. Install actuators in locations that are easy for people with disabilities to reach.
 - 5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- F. Toilet Seat Installation:
 - 1. Place new toilet seat on bowl and align bolt holes with mounting holes in bowl. Hand tighten bolts, do not overtighten for risk of damaging vitreous china. [Provide check hinges on open-front style toilet seats.
- G. Mop Sink:

1. Provide accessible check valves on the hot and cold-water supply piping serving all mop sinks.
- H. Lavatory, Sink, and Laundry Tray Installation:
1. Install level and plumb according to roughing-in drawings.
 2. Install supports, affixed to building substrate, for wall-mounted lavatories.
 3. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
 4. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
 5. Provide independent check valves in both hot and cold water supply piping serving thermostatic mixing valves.
 6. Install counter-mounting fixtures in and attached to casework.
 7. Install wall-hung lavatories on concealed carriers and secured to wall.
- I. Faucet Installation:
1. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 2. Provide independent check valves in both hot and cold water supply piping serving thermostatic mixing valves.
- J. Drinking Fountain and Water Cooler Installation:
1. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
 2. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

End of Section 224000.00

SECTION 23051 - COMMON REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Shop Drawings

1. Coordination Drawings: This contractor shall provide necessary coordination drawings required to make sure all disciplines are coordinated and fit into specified spaces (i.e. ceilings, chases, and all others). It is the work of the contractor to prepare complete coordination drawings indicating exact location, clearances and penetrations of all items of all trades.

1.2 RELATED DOCUMENTS

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

1.3 GENERAL DIRECTION

- A. Submittal of a bid indicates that the contractor has examined the drawings, specifications, and had an opportunity to visit the site to be able to provide a comprehensive complete bid.
- B. The intent of these specifications and the accompanying drawings is to provide complete and workable systems as shown, specified and required by applicable codes. Interpret these specifications in conjunction with the drawings and provide all work described. If work is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both. Should there be a conflict between the specifications and drawings, provide the greater quantity or better quality. Immediately notify owner's representative and design professional of such conflicts.
- C. The drawings that accompany these specifications are diagrammatic and although size and location of equipment is drawn to scale wherever possible make use of submittal data and verify all dimensions on site. They do not show every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts. Follow the drawings as closely as is practical and install additional bends, offsets and elbows where required by site conditions and codes at no additional cost. Install all new work in such manner as to conform to the structure, avoid obstructions, provide required service clearances and preserve headroom. Do not scale from drawings, all measurements should be taken in the field.
- A. Coordinate all work with all other contractors and installers in addition to existing building obstructions and install accordingly. Comply with requirements of architectural drawings including but not limited to mounting height and locations. Fully research peculiarities and limitations of space available for installation of work with materials being provided. Work around material lead times to not extend project schedule.

- B. Complete work, or part(s) thereof, at times as may be designated by the Owner's Representative, so that it can be used for temporary or permanent use. Do not construe such use of the system as an acceptance of it by Owner.
- C. During mobilization or construction, if an abnormal condition is uncovered either with existing conditions, equipment loads, submittal data, etc. bring these to the attention of the Design Professional for review.
- D. Owner's Representative or Design Professional may relocate devices prior to installation within a 20-foot limit at no additional charge.
- E. All ducts shall be run as straight as possible and symmetrical with architectural items. Ductwork fabricated before coordination with the other trades will be done at the contractor's risk.
- F. Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore said service. The Contractor shall provide tools, materials, skilled journeymen of Bidder/Proposer's own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without requests for extra compensation from the Owner.
- G. Each Bidder/Proposer shall also be governed by any unit prices and Addenda insofar as they may affect part of their work or services.

1.4 GENERAL STANDARDS

- A. Provide materials, installation methods, workmanship, testing, etc., in strict accordance with the latest edition of applicable standards and adopted codes, including (but not limited to) the following.
 - 1. State Building Code and applicable local amendments.
 - 2. Local Building Code (if applicable)
 - 3. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - 4. American Society of Test Materials (ASTM)
 - 5. National Fire Protection Association (NFPA)
 - 6. Underwriters Laboratories (UL)
 - 7. National Sanitation Foundation (NSF)
 - 8. Sheet Metal & Air Conditioning Contractors National Association (SMACNA)
 - 9. American National Standards Institute (ANSI)
 - 10. Building Code Seismic Relative Displacement Requirements

1.5 PERMITS AND REGULATIONS

- A. Obtain and pay for permits, fees, certificates of inspection and approval, etc. required for this branch of the work. Furnish Owner with certificates of final inspection and approval prior to final acceptance of this branch of the work.
- B. Laws and regulations which bear upon or affect the various branches of this work shall be complied with by this contractor and are hereby made a part of this contract.

1.6 DEFINITIONS

- A. Contractor - Any Contractor whether bidding, proposing or working independently or under the supervision of a General Contractor, Prime Contractor, Construction Manager and who installs any type of Mechanical Work as specified in the Contract Documents or, the General Contractor.
- B. Engineer - The Consulting Mechanical-Electrical Engineer either consulting to the Owner, Architect, or Other, etc. In this case: CMTA, Inc., Consulting Engineers.
- C. Architect - The Architect of Record for the project.
- D. Contract Documents - All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Contract with Owner, etc.
- E. Bidder/Proposer - Any person, agency or entity submitting a proposal to any person, agency or entity for any part of the work required under this contract.
- F. The Project - All of the work required under this Contract.
- G. Furnish - Procure, supply and deliver to project site, ready for installation, install and warrant (unless indicated otherwise on documents). Include warranty expenses.
- H. Install - To supply labor, tools and incidental materials necessary to handle, store, mount, terminate, program, configure and adjust a product in order render the respective product and system fully operational and usable to the Owner for the intended purpose.
- I. Provide - Furnish and Install. Similar Terms: "include", "shall", "equip with", "consisting of".
- J. Equal or Equivalent - Determination of equivalency to be made by design professional for all products not listed as basis-of-design.
- K. Indicated - Listed in the Specifications, shown on the Plans or Addenda thereto.
- L. Typical or Typ.- Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.
- M. Substantial Completion - Where frontend documentation does not define, products and systems must be fully installed as designed, tested, adjusted, labeled, and functionally demonstrated to owner.

1.7 REQUESTS FOR INFORMATION

- A. Submit all questions, requests for information (RFIs) and similar queries through the formally-established RFI process for the project that has been accepted by the Owner's Representative, Design Professionals, Prime Contractor and subcontractors. Submit as a PDF file. Do not submit as text in an email.

1.8 AVAILABILITY OF ELECTRONIC DRAWINGS

- A. If expressly permitted by the Owner and the terms of the Contract, editable electronic drawings may be made available for the creation of shop and as-built drawings upon request. Drawings will be made available at the discretion of the Engineer.
- B. "Drawing Release" form can be obtained from the CMTA project manager upon request.

1.9 QUALITY ASSURANCE

- A. Contractor shall have a minimum five (5) years' experience in the installation of systems similar to the systems specified. Contractor, if requested, shall demonstrate his ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of the contractor's inability to perform.

1.10 INTENT AND INTERPRETATION

- A. It is the intention of the Contract Documents to call for a complete and operational system, including all components, accessories, finish work, etc as necessary for trouble free operation; tested and ready for operation. Anything that may be required, implied, or inferred by the Contract Documents shall be provided and included as part of the Bid.
- B. All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- C. Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
- D. The Bidder/Proposer shall completely review the Contract Documents. Any interpretation as to design intent or scope shall be provided by the Engineer / Architect. Should an interpretation be required, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event of any conflict, discrepancy, or inconsistency develops; the interpretation of the Engineer shall be final.
- E. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten (10) days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in the bid, and that will be responsible for the approved satisfactory functioning of the entire system without extra compensations.

1.11 CODES, RULES, PERMITS, FEES, INSPECTIONS, REGULATIONS, ETC.:

- A. The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, inspections and other costs, including all utility connections, meters, meter settings, taps, tap fees, extensions, etc. in connection with their work. They shall also file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments and/or the appropriate municipality or utility company having jurisdiction, whether indicated or specified or not. They shall also obtain all required certificates of inspection for their work and deliver same to the Engineer before request for acceptance and final payment for the work.
- B. Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.
- C. The Contractor shall include in their work, without extra cost, any labor, materials, services, apparatus and Plans in order to comply with all applicable laws, ordinances, rules and regulations, whether or not indicated or specified.
- D. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, with the requirements of local utility companies, or municipalities and with the requirements of all governmental agencies having jurisdiction.
- E. All materials and equipment so indicated and all equipment and materials for the electrical portion of the mechanical systems shall bear the approval label of, or shall be listed by the Underwriters' Laboratories (UL), Incorporated. Each packaged assembly shall be approved as a package. Approval of components of a package shall not be acceptable.
- F. All plumbing work is to be constructed and installed in accordance with applicable codes, Plans and Specifications which have been approved in their entirety and/or reflect any changes requested by the Authority Having Jurisdiction. Plumbing work shall not commence until such Plans are in the possession of the Plumbing Contractor.
- G. All Heating, Ventilation and Air Conditioning work shall be accomplished in accordance with the Building Code and amendments thereto, the latest standards recognized by the American Society of Heating, Refrigerating and Air Conditioning and the National Fire Protection Association.
- H. The Contractor shall furnish three (3) copies of all Final Inspection Certificates obtained to the Engineer when work is complete. Final payment for work will be contingent upon compliance with this requirement.
- I. Where minimum code requirements are exceeded in the Design, the Design shall govern.
- J. The Contractor shall ensure that their work is accomplished in accord with the OSHA Standards and that they conduct their work and the work of their personnel in accord with same.
- K. All work relating to the handicapped shall be in accord with regulations currently enforced by the Authority Having Jurisdiction and the American Disabilities Act.
- L. Discharge of any toxic, odorous or otherwise noxious materials into the atmosphere or any system shall be subject to regulations of the Environmental Protection Agency (EPA) and/or the air pollution control commission. If in doubt, contact the State Department for Environmental Protection.

- M. Where conflict arises between any code and the Plans and/or Specifications, the code shall apply except in the instance where the Plans and Specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten (10) days prior to bid date, otherwise the Contractor shall make the required changes at their own expense.

1.12 PLANS AND SPECIFICATIONS:

- A. The Plans are diagrammatic only and indicate the general arrangement of the systems and are to be followed. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Engineer for approval before proceeding with the work. The Plans are not intended to show every item which may be necessary to complete the systems. All Bidder/Proposers shall anticipate that additional items may be required and submit their Bid accordingly.
- B. The Plans and Specifications are intended to supplement each other. No Bidder/Proposer shall take advantage of conflict between them, or between parts of either. Should this condition exist, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be final.
- C. The Plans and Specifications shall be considered to be cooperative and anything appearing in the Specifications which may not be indicated on the Plans or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
- D. Contractor shall make all of their own measurements in the field and shall be responsible for correct fitting. The work shall be coordinated with all other branches of work in such a manner as to cause a minimum of conflict or delay.
- E. The Engineer shall reserve the right to make adjustments in location of piping, ductwork, equipment, etc. where such adjustments are in the interest of improving the project.
- F. Should conflict, overlap or duplication of work between the various trades become evident, this shall be called to the attention of the Engineer. In such event neither trade shall assume to be relieved of the work which is specified under their branch until instructions in writing are received from the Engineer.
- G. Unless dimensioned, the Plans only indicate approximate locations of equipment, piping, ductwork, etc. Dimensions given in figures on the Plans shall take precedence over scaled dimensions and all dimensions, whether given in figures or scaled, shall be verified in the field to insure no conflict with other work.
- H. Each Bidder/Proposer shall review all Plans in the Contract Documents to ensure that the work they intend to provide does not create a conflict with or affect the work of others in any way. Where such effect does occur, it shall be the Bidder/Proposer's responsibility to satisfactorily eliminate any such conflict or effect prior to the submission of their proposal. Each Bidder/Proposer shall in particular ensure that there is adequate space to install their equipment and materials. Failure to do so shall result in the correction of such encroachment conflict or effect of any work awarded the Bidder/Proposer and shall be accomplished fully without expense to others and that they are

reasonably accessible for maintenance. Check closely all mechanical and electrical closets, chases, ceiling voids, wall voids, crawl spaces, etc., to insure adequate spaces.

- I. Where on the Plans a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornamentation or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.
- J. Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
- K. Where within the Contract Documents the word "typical" or "typ." is used, it shall mean that the work method or means indicated as typical shall be repeated in and each time it occurs whether indicated or not.
- L. Each Contractor shall evaluate ceiling heights specified on Architectural Plans. Where the location of equipment or systems may interfere with ceiling heights or maintenance and access of equipment or systems, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Do not install equipment or systems in the affected area until the conflict is resolved. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work or cost incurred on the part of the Contractor or unduly delay the work.

1.13 COOPERATION AND COORDINATION WITH OTHER TRADES:

- A. The Contractor shall give full cooperation to all other trades and shall furnish in writing with copies to the Engineer, any information necessary to permit the work of other trades to be installed satisfactorily and with the least possible interference or delay.
- B. Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than $\frac{1}{4}" = 1'-0"$, clearly indicating how their work is to be installed in relation to the work of other trades, or so as not to cause any interference with work of other trades. Make the necessary changes in the work to correct the condition without extra charge.
- C. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

1.14 COST BREAKDOWNS (SCHEDULE OF VALUES):

- A. Within thirty (30) days after acceptance of the Contract, the Contractor shall furnish to the Engineer, one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made in a format approved by the Engineer. Payments will not be made until satisfactory cost breakdowns are submitted.

1.15 HAZARDOUS MATERIALS:

- A. The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building or site.
- B. Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of their work, ensure that their workers are aware of this potential and what they are to do in the event of suspicion. The Contractor shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall insure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.
- C. CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling or disposal of such material.
- D. If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner and so advise them immediately.
- E. The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.
- F. No asbestos or mercury containing materials shall be installed in this project.

1.16 INDEMNIFICATION:

- A. The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

1.17 TEMPORARY SERVICES:

- A. The Contractor shall arrange any temporary water, electrical and other services which may be required to accomplish the work. Refer also to General and Special Conditions.
- B. All temporary services shall be removed by Contractor prior to completion of work.

1.18 WARRANTY / GUARANTEE

- A. Provide a warranty/guarantee in written form as part of O&M manual stating that all work, materials, equipment and parts are warranted to be free of defect for a minimum period of one year from the date of Substantial Completion. Warranty period and requirements may be expanded in drawings or subsequent specification sections. Repair or replace (owner's option) any defects or failures at no cost to the owner within the warranty period. Issues arising within warranty period must be attended to in a timely manner and in no case exceed four (4) working days. State this in writing as part of O&M manual. Replace defective items to the satisfaction of the Owner's Representative and the Design Professional.

1.19 SURVEY, MEASUREMENTS AND GRADE:

- A. The Contractor shall lay out their work and be responsible for all necessary lines, levels, inverts, elevations and measurements. The Contractor must verify the figures shown on the Plans before laying out the work and will be held responsible for any error resulting from failure to do so.
- B. The Contractor shall base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.
- C. Should the Contractor discover any discrepancy between actual measurements and those indicated which prevents following good practice or the intent of the contract documents, the Contractor shall promptly notify the Engineer and shall not proceed with this work until the Contractor has received instructions from the Engineer on the disposition of the work.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide materials that are new, full weight, of the best quality. Obtain equipment, components and materials from single manufacturer for products of the same kind or category. Provide materials that are listed and labeled and marked for intended location and application.
- B. Provide basis of design products or listed products equivalent in quality, performance, aesthetics, and product support (factory and local) to that specified as basis of design. Products not basis of design are subject to review by the Design Professional and possible rejection. Listing of a product manufacturer by name alone as an equivalent manufacturer shall not equate all products offered by that manufacturer to the basis of design.
- C. Bear all costs incurred from deviation from basis-of-design materials, methods, labor, services, etc. Use of materials, methods, labor, services, etc. that deviate from the basis-of-design will be considered a statement that capacities, requirements, clearances, arrangements, performance, etc. have been checked, verified, found satisfactory, and align with intent of specified work and applicable codes and regulations.

- D. Should deviation from basis of design equipment impact other contractor's scope of work it shall be the responsibility of this contractor to coordinate with and cover these costs in addition to their own. This specifically includes electrical deviations from basis of design.
- E. All manufacturer or contractor provided electrical disconnect switches shall comply with current National Electric Code requirements and rated to meet or exceed the overcurrent device serving the equipment.

PART 3 - EXECUTION

3.1 GENERAL DIRECTION

- A. Unless specifically indicated, provide all specified and drawn work as required to render all equipment and systems fully operational, including all ancillary, accessory, and support work. Install equipment and materials in strict accordance with manufacturer's written instructions.
- B. In cases where products / materials are furnished by Owner or others, provide the following services: receive, transport and securely store materials on site; remove materials and components from packaging; assemble all materials and components per factory instructions; install, wire and connect materials and components as recommended by manufacturer for a fully operational installation.
- C. Remove and replace items that impede new work installation including but not limited to fencing, doors, gypsum, lift-out panels, and structures to provide pathway for moving equipment into place.
- D. Examine surfaces to receive products for suitable mounting conditions and verify compliance with installation tolerances and other conditions affecting performance of the work. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Equipment shall be installed in accordance with manufactures installation recommendations. Provide and maintain service, maintenance and operating clearances as required by the manufacturer.

3.2 SUPERVISION AND WORKMANSHIP

- A. Workmanship throughout shall conform to the standards of best practice and all labor employed must be competent and qualified to do all the work required.
- B. Contractor shall furnish the services of an experienced superintendent to be in constant charge of the work at all times. The superintendent's qualifications are subject to the review and acceptance by the Owner's Representative. Utilize the same mechanical superintendent throughout the duration of the project.
- C. Provisions shall be made for owner's representative or design professional to make rough-in and open ceiling inspections prior to covering up work.

3.3 CHANGE OF WORK

- A. In the event of revised scope or work formally issued through Change of Work order, contractor shall provide an itemized breakdown of pricing and receive approval prior to commencing work.
- B. All pricing shall be in alignment with industry standard labor rates and estimated hours (based on RSMeans data). Any additional material or equipment shall be passed through with the standard industry excepted mark-up. All labor hours, labor rates, material costs, and equipment costs are subject to further questioning and approval from the Engineer.
- C. All work commencing prior to approval will be at the risk of the contractor.

3.4 ARCHITECTURAL COORDINATION ITEMS

- A. Cutting and Patching:
 - 1. Cut and drill all openings in roofs, walls, and floors required for the installation. Neatly patch all openings cut. Hold cutting and patching to a minimum by arranging with other contractors for all sleeves and openings before construction is started.
- B. Fire Caulking:
 - 1. Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch.
 - 2. Provide products equivalent to the following:
 - a. For Floor Openings: 3M; Fire Barrier Sealant CP 25WB+
 - b. For Wall Openings: 3M; Fire Barrier Sealant CP 25WB+
 - c. Mineral Felt: Rockwool; Firepro Firestop Compound
 - d. For Insulated Pipes: 3M; Fire Sealant System CAJ5211
 - e. For Fill Areas: 3M; Fire Barrier Packing Material PM 4
 - 3. For larger openings where pipes penetrate fire rated enclosures that cannot be sealed with products described above, utilize approved UL products equal to 3M FireDam Spray 200.
- C. Access Panels:
 - 1. Provide all access panels required for proper servicing of equipment. Provide fire rated access panels at fire rated assembly penetrations rated at or above the fire rating of the assembly. Provide frame as required for finish. Coordinate installation with General Contractor as they may elect to install access panel. Exact location(s) must be approved by the Architect. Minimum size to be 12" x 12", units to be 16-gauge steel, primed for paint, and locking device shall be screwdriver cam locks.
 - 2. For equipment above gypsum board or "hard ceilings", provide equipment access panels sized to permit complete holistic removal of the unit in its entirety. Access panel shall also be sized to accommodate removal of the largest piece of equipment in the case where such access panel is used as a removal pathway for multiple pieces of equipment.
- D. Piping Sleeves:

1. Install standard Schedule 40 black steel pipe sleeves two sizes larger than pipes passing through floors, walls or masonry construction. Cut flush with both faces of wall. Floor sleeves shall extend one inch above floor top elevation. Roof penetrations shall be within a pipe curb assembly equal to Pate Co. Curb and flashing per roofing manufacturer's requirements to maintain warranty.
2. Install rockwool and/or caulk between pipe and sleeve. Material must meet all applicable fire ratings.

E. Piping Escutcheon plates:

1. Install manufactured chromium plated escutcheon plates wherever uninsulated exposed pipes pass through walls, floors, or ceilings. Escutcheon inside diameter to closely fit around pipe and outside diameter to completely cover opening.

F. Expansion Joints:

1. Provide flexible connectors where all pipes or ducts cross building expansion joints. Coordinate exact quantity & location with Architectural plans prior to installation of piping or ductwork.

3.5 PROTECTION OF EQUIPMENT AND SURFACES

- A. Make every effort to protect roofs, walls and floors from foot traffic, equipment, carts, lifts, etc.
- B. Make roof penetrations and install insulated roof curbs and flashing in accordance with roofing manufacturer's recommendations. Obtain written certification from roofing manufacturer that work has been performed properly and that roof warranty is intact.
- C. The Contractor shall be entirely responsible for all material and equipment they furnish in connection with their work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. All piping, etc., shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged, stolen or vandalized while stored on site, either before or after installation, shall be repaired or replaced by the Contractor at their expense. All ductwork with open ends shall be covered with plastic during construction.

3.6 REQUIRED CLEARANCES FOR ELECTRICAL EQUIPMENT

- A. The NEC has specific required clearances above, in front, and around electrical gear, panels etc. The Contractor shall not install any piping, ductwork, etc., in the required clearance. If any appurtenance is located in the NEC required clearance, it shall be relocated at no additional cost. Coordinate with the Electrical Contractor prior to any work.

3.7 EQUIPMENT SUPPORT

- A. Each piece of equipment, apparatus, piping, or conduit suspended from the ceiling or mounted above the floor level shall be provided with suitable structural support, pipe stand, platform or carrier in

accordance with the best recognized practice. Such supporting or mounting means shall be provided by the Contractor for all equipment and piping. Exercise extreme care that structural members of building are not overloaded by such equipment. Provide any required additional bracing, cross members, angles, support, etc. Do not support items from roof/floor deck or bridging.

3.8 DUCT AND PIPE MOUNTING HEIGHTS

- A. All exposed or concealed ductwork, piping, etc., shall be held as high as possible unless otherwise noted and coordinated with all other trades. Exposed piping and ductwork shall, insofar as possible, run perpendicular or parallel to the building structure. Refer to Plans for minimum heights of ducts and piping. Minimum height above ceilings shall be 6" clear including insulation, unless otherwise noted.

3.9 BROKEN LINES AND PROTECTION AGAINST FREEZING

- A. No conduits, piping, etc. carrying water or any other fluid subject to freezing shall be installed in any part of the building where danger of freezing may exist without adequate protection being given by the Contractor whether or not insulation is specified or indicated on the particular piping. All damages resulting from broken and/or leaking lines shall be replaced or repaired at the Contractor's own expense. Do not install piping across or near openings to the outside whether or not they are carrying static or moving fluids. Insulation on piping does not necessarily ensure that freezing will not occur. If in doubt, contact the Engineer.

3.10 WEATHERPROOFING:

- A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as specified and approved by the Architect and Engineer before work is performed. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings permanently watertight.
- B. Wherever work penetrates roofing, it shall be done in a manner that will not diminish or void the roofing guarantee or warranty in any way. Coordinate all such work with the roofing installer.

3.11 FINAL CONNECTIONS TO EQUIPMENT:

- A. The Contractor shall finally connect mechanical services (water, sanitary, gas, air, etc.), to any terminal equipment, appliances, kitchen equipment, etc., provided under this and/or other divisions of the work. Various equipment connections indicated are based upon "basis of design" equipment selections. Should alternate equipment be purchased by the General Contractor, then this Contractor shall make the necessary provisions in the Bid for any and all differences. Change Orders shall not be considered for any differences due to alternate equipment purchase. Such connections shall be made in strict accord with current codes, safety regulations and the equipment manufacturer's recommendations. If in doubt, contact the Engineer prior to installation.

3.12 UTILITY VERIFICATION REQUIREMENTS

- A. Field verify locations of underground and aboveground utilities, or those otherwise obscured from view, in the vicinity of work prior to commencing work. Utilize "811" call before you dig and hire locating service to identify, locate and mark remaining utilities and private lines.
- B. Camera scope and dye testing existing piping, ductwork and pathways to confirm existing conditions and use including, but not limited to, voltage, natural gas pressure, sanitary, storm, chilled water, steam, etc.)
- C. Obtain on-site approval from local utility prior to connecting to existing services.
- D. Failure to perform the above shall result in contractor proceeding at their risk and accepting full responsibility for incorrect connections.

3.13 ACCESSIBILITY:

- A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in double partitions and ceilings for the proper installation of their work. They shall cooperate with all others whose work is in the same space. Such spaces and clearances shall, however, be kept to the minimum size required.
- B. The Contractor shall locate and install all equipment so that it may be serviced, and maintained as recommended by the manufacturer. Allow ready access and removal of the entire unit and/or parts such as valves, filters, fan belts, motors, prime shafts, controls, coils, etc.
- C. Whether shown on the Plans or not, the Contractor shall provide in the Bid access panels for each concealed shut-off valve, motorized control damper, manual air damper or other device requiring service as shown on Engineer's Plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work. Change orders for access panels will not be accepted.

3.14 SCAFFOLDING, RIGGING AND HOISTING:

- A. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery onto the premises of any equipment and apparatus furnished. All such temporary appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

3.15 DELIVERY, STORAGE, HANDLING, AND PROTECTION

- A. Receive, inspect, store and protect all materials required for new work. Do not accept or install any product damaged in any way.
- B. Comply with all manufacturer guidelines and requirements for movement, storage, and protection of new work. All new work must be stored in a clean, dry place protected from weather and construction

traffic. Maintain acceptable temperature and humidity per manufacturer recommendations. When stored inside or during transport through building, do not exceed structural capacity of the floor.

- C. Coordinate and account for sizes of all new work included shipping materials with available openings. Account for rigging of all new work as required and as intended by manufacturer.
- D. Do not install work until work area is sufficiently weathertight, all wet work in area is complete and all work above is complete.
- E. Prior to installation, all products shall have the ability to be returned to the supplier or manufacturer after purchase and charged a reasonable restocking fee equal to a small portion of the cost.
- F. Protect all new work through construction from damage. Take safeguards necessary to protect from damage. Items damaged during construction will not be accepted and shall be replaced with new.
- G. Remove and replace all materials that have been installed improperly, physically damaged, moisture or water damaged, or mold damaged.
- H. Fully remove all packaging materials inside and out prior to startup.

3.16 LOW VOLTAGE CONTROL WIRING FOR MECHANICAL EQUIPMENT

- A. 120VAC Temperature Control Circuits
 - 1. Electrical Contractor shall provide all 120 Volt power wiring as required for temperature control panels and transformers to low voltage. Electrical Contractor shall connect to existing spare at electrical panel board and provide proper circuit breaker per NEC and label panel board accordingly. Mechanical contractor and temperature controls contractor shall coordinate with the electrical contractor accordingly.
 - 2. All other required 120VAC raceway and wiring related work shall be provided by the Electrical Contractor.
 - 3. The Electrical Contractor shall coordinate with the General Contractor to ensure thermal envelope is maintained at these locations.

3.17 FIRE ALARM RELATED WORK FOR MECHANICAL SYSTEMS

- A. The drawings and specifications for this project require specific fire alarm devices, connections, wiring and programming associated with this division of work.
- B. The electrical contractor will be installing a new fire alarm system or making modifications to an existing fire alarm control panel. Coordinate all fire alarm connections and programming that will be required with the electrical contractor to fulfil this division of work. This coordination shall take place at the start of the project so that all devices may be shown on fire alarm shop drawings.
- C. Fire alarm devices to satisfy the requirements of this division of work will be furnished by the electrical contractor, installed by the mechanical contractor, wired and programmed by the electrical contractor. Mechanical and electrical contractor shall perform and be present for all tests of the system.

- D. All required mechanical shutdowns of equipment shall be coordinated with the electrical contractor and with submitted equipment and performed in a controlled and safe manner in the presence of smoke. This shall be done via hardwired contacts and not via Building Automation System.
 - 1. Whether shown on the drawings or not, all air handling units over 2000 CFM that serve more than one space shall have duct smoke detectors located in the return duct of each unit in accordance with the current State Mechanical Code, and NFPA 90A. The duct smoke detector shall be equipped with an auxiliary relay that immediately cuts power to the fan motor and notifies the fire alarm panel. All related work shall be coordinated accordingly with the electrical contractor. The duct detectors shall be installed downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 2,000 cfm. Where the duct detector cannot be located ahead of branch connections, multiple duct detectors shall be used to satisfy the intent of the code. Return system smoke detectors are not required when the entire space served by the air distribution system is protected by a system of area smoke detectors

3.18 CLEANING:

- A. The Contractor shall, at all times, keep the area of their work presentable to the public and clear from rubbish and debris caused by their operations; and at the completion of the work, they shall remove all rubbish, debris, all of their tools, equipment, temporary work and surplus materials from and about the premises, and shall leave the area clean and ready for use. If the Contractor does not attend to such cleaning upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the Contractor. The Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of their rubbish or debris.
- B. After completion of all work and before final acceptance of the work, the Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of piping, equipment, fixtures and all other associated or adjacent fabrication.
- C. Ductwork and piping shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic. Installed ductwork shall be protected with plastic. Do not install the ductwork or insulation (pipe or duct) if the building is not "dried-in". If this is required, the entire lengths of duct shall be covered in plastic to protect. The Owner/Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing a NADCA certified Contractor.

3.19 TEMPORARY USE OF EQUIPMENT:

- A. The permanent heating and cooling equipment, when installed, may be used for temporary services, with the consent of the Engineer. Should the permanent systems be used for this purpose the Contractors shall make all temporary connections required at their expense. They shall also make any replacement required due to damage wear and tear, etc., leaving the same in "as new" condition.
- B. Permission to use the permanent equipment does not relieve the Contractors from the responsibility for any damages to the building construction and/or equipment which might result because of its use.

- C. Warranties shall begin at substantial completion regardless of temporary use of equipment or not.
- D. A pre-start-up conference shall be held in accordance with EQUIPMENT/CONTROLS START-UP AND VERIFICATION in this section.

3.20 NOISE, VIBRATION OR OSCILLATION

- A. All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Engineer. In case of moving machinery, sound or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner by the Contractor at their expense.
- B. All equipment subject to vibration and/or oscillation shall be mounted on vibration supports whether indicated or not suitable for the purpose of minimizing noise and vibration transmission, and shall be isolated from external connections such as piping, ducts, etc. by means of flexible connectors, vibration absorbers, or other approved means.
- C. Unitary equipment, such as room units, exhaust fans, etc., shall be rigidly braced and mounted to wall, floor or ceiling as required and tightly gasketed and sealed to mounting surface to prevent air leakage and to obtain quiet operation. Flush and surface mounted equipment such as diffusers, grilles, etc., shall be gasketed and affixed tightly to their mounting surface.
- D. The Contractor shall provide supports for all equipment they furnish. Supports shall be liberally sized and adequate to carry the load of the equipment and the loads of attached equipment, piping, etc. All equipment shall be securely fastened to the structure either directly or indirectly through supporting members by means of bolts or equally effective means. If strength of supporting structural members is questionable, contact Engineer.

3.21 EQUIPMENT/CONTROLS STARTUP & VERIFICATION

- A. The Contractor and their Subcontractors shall include in the bid to provide equipment and controls startup and verification for ALL Mechanical Systems specified for this project.
- B. A pre-start-up conference shall be held with the Architect, Engineer, Owner, General Contractor, Mechanical Contractor, Electrical Contractor, Controls Contractor, Test and Balance Contractor, and the Manufacturer's providing startup services. The purpose of this meeting will be discussing the goals, procedures, etc. for start-up.
- C. Specific line-items shall be included on the schedule of values by each Trade for "equipment and controls startup". These line-item values shall be approved by the Engineer. The Engineer, Owner and the Engineer's Field Inspector(s) shall closely monitor progress and quality of the equipment and controls startup and may withhold pay requests as deemed appropriate until satisfactorily completed.
- D. Specific startup/verification specifications are included throughout the Mechanical Specifications. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians, not third-party contractors, and shall complete and submit start-up reports/checklists. The Contractor shall have appropriate trades on site to correct all deficiencies

noted by the factory representative. For each deficiency noted, documentation of corrective action (including date and time) shall be submitted to the Engineer and Owner. Where factory start-up is not specified for a particular piece of equipment or system, the Contractor shall be responsible to perform start-up. All information shall be completed by the Contractor and submitted to the Owner/Engineer prior to acceptance of the equipment.

- E. The Contractor shall be responsible for completion of System Verification Checklists/Manufacturer's Checklists. Factory startup is required for all HVAC equipment noted. Unless noted otherwise, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians and shall complete and submit start-up reports/checklists.
- F. The manufacturer's recommended startup procedures and checklists will be acceptable for use in the project. Where "manufacturer" startup is not specified, then this Contractor shall perform startup services in strict accordance with manufacturer's instructions. All startup/verification process shall be thoroughly documented by the Contractor and shall include the time and date when performed.
- G. The Contractor shall "zip-tie" a start-up report to each piece of equipment in a clear plastic cover. Once start-up completion is verified by the Engineer the Contractor shall remove all reports and consolidate them into close-out documentation. The Contractor shall be responsible for completion of System Verification Checklist (SVC) / Manufacturer's Checklists.

3.22 INSPECTION, APPROVALS AND TESTS:

- A. Before requesting a final review of the installation from the Architect and/or Engineer, each Contractor shall thoroughly inspect their installations to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineer for unnecessary and undue work on their part.
- B. The Contractor shall provide as a part of this Contract any required Agency inspection, licensed and qualified to provide such services. All costs incidental to the provisions of inspections shall be borne by the Contractor.
- C. The Contractor shall advise each Inspecting Agency in writing, with an informational copy of the correspondence to the Architect and/or Engineer, when they anticipate commencing the work. Inspections shall be scheduled for rough-in as well as finished work. The rough-in inspections shall be divided into as many inspections as may be necessary to cover all rough-in without fail. Failure of the Inspecting Agency to inspect the work in a timely manner and submit the related reports may result in the Contractor having to expose concealed work not so inspected. Such exposure will be at the expense of the responsible Contractor.
- D. Approval by an Agency Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these Plans and Specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.
- E. Before final acceptance, the Contractor shall furnish the original and three (3) copies of the certificates of final approval by the Agency Inspector to the Engineer with one copy of each to the

appropriate government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.

3.23 ABOVE-CEILING AND FINAL PUNCH LISTS:

- A. The Contractor shall review each area and prepare and complete their own punch list for each of the subcontractors as required for the Project Schedule.
- B. Seven (7) days' notice shall be given to the Engineer for review of above ceiling work that will be concealed by tile or other materials. Seven (7) days' notice shall be given to the Engineer for review of below ceiling work and final inspection.
- C. When all work from the Contractor's punch list is complete at each of the major Project Stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing seven (7) days prior to the proposed date. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review. The Contractor's representative may be requested at the inspections.
- D. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due net 10 days from date of each additional visit) at a rate of \$125.00 per hour plus travel expense for extra trips required to complete either of the above ceiling, below ceiling or final punch lists.

3.24 OPERATING INSTRUCTIONS

- A. Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating the systems and equipment for a period of three (3) days of eight (8) hours each, or as otherwise specified. Refer to Section HVAC EQUIPMENT for additional requirements. During this period, instruct the Owner or their representatives fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least seven (7) days written notice to the Owner, Architect and Engineer in advance of this training period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representatives that were present.
- B. Each Contractor shall furnish three complete bound sets for approval to the Engineer instructions for operating and maintaining all systems and equipment included in this contract. All instructions shall be submitted in draft form, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions. Refer to Specification Section SHOP DRAWINGS for additional detail.
- C. Each Contractor, in the above-mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this contract and a detailed, easy to read parts list and the name and address of the nearest source of supply.

3.25 RECORD DRAWINGS:

- A. The Contractor shall insure that any deviations from the Design are as they occur recorded in red, erasable pencil on record drawings kept at the jobsite. The Engineer shall review the record documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Pay particular attention to the location of under floor sanitary and water lines, shut-off valves, cleanouts and other appurtenances important to the maintenance and operation of Mechanical Systems. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose and deliver to the Engineer upon completion of the work.

3.26 DEMONSTRATION / TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment. Refer to product specific specification for training types and duration.

END OF SECTION 230501

SECTION 230505 - EXISTING CONDITIONS AND DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Prior to submitting a bid, the Mechanical Contractor shall perform a detailed walk-through field inspection, to review the existing structures and premises, to determine all existing conditions, equipment/ductwork/piping locations, etc. and shall make all necessary allowances for all required mechanically related demolition and relocation work. This pre-bid inspection by the Mechanical Contractor shall include inspection of all applicable accessible ceiling cavity, areas, etc.
- B. Should the Mechanical Contractor take any exceptions to providing any related demolition or relocation work, such exceptions shall be stated in detail within the Prime Contractor's bid. No subsequent allowance to the contract cost shall be made for any insufficient allowances made by the Mechanical Contractor during bidding which may result from the Mechanical Contractor's failure to visit job site and review drawings.
- C. The Mechanical Contractor shall confirm the working operation and condition of existing systems to remain. The Mechanical Contractor shall note any malfunctioning systems, system deficiencies or any other noteworthy system items prior to commencement of work. The Mechanical Contractor shall provide a written systems condition assessment report to the owner prior to commencement of work. The owner shall sign the assessment report acknowledging the condition of the existing systems. The Mechanical Contractor shall protect these existing systems and shall be responsible for these systems during demolition and construction. The Mechanical Contractor shall be responsible for turning these existing systems back over to the owner in the same operating condition as the contractor received it. The mechanical contractor shall be responsible for repairing or replacing any malfunctioning systems, components or deficient systems to the satisfaction of the owner that have not been noted on the written systems condition assessment report. The mechanical contractor shall be responsible for all existing system components and operation in the absence of an owner-signed systems condition assessment report.
- D. Demolition related work may not be specifically indicated on drawings, but shall be included under base bid. All mechanically related demolition, relocation, etc. work, including work described herein, shall be under base bid.
- E. It is not the intent of these contract documents that existing conditions be accurately shown. Existing mechanical work is shown to a limited extent on drawings and is shown for general planning reference only. Such locations, etc. have been located from portions of contract documents which were prepared for previously installed work (not from "as-builts"). These locations are not guaranteed. The successful Mechanical Contractor shall have access to all available existing building/system plans and specifications.
- F. The existing ductwork and piping systems may be utilized only to the extent indicated herein or on drawings and/or as directed by Owner's representative in field.

- G. Routing of all new ductwork and piping work in existing buildings shall be approved by Owner's representative prior to installation.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 EFFECT ON ADJACENT OCCUPIED AREAS

- A. Locate, identify, and protect existing mechanical services passing through demolition areas and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services (including proper filtration) for affected areas.
- B. It is recognized that there may be some ductwork and/or piping systems rendered inactive by demolition, causing disconnection of "downstream" terminals, equipment, etc. which serve occupied areas. It shall be the responsibility of the Mechanical Contractor to investigate these types of conditions (for all systems) prior to demolition. Provide all necessary corrective mechanical work prior to demolition to ensure that such "downstream" work remain permanently active throughout demolition, new construction and after project completion.
- C. All work and system shutdowns shall be carefully coordinated in advance with owner's representative and all affected trades so that normal building activities and other construction trades are minimally affected. All required mechanical related demolition and/or new construction work, which will affect any and all occupied areas (including those which are located outside the immediate area of project work) shall be performed at special times if/as directed by Owner's representative in field.
- D. All existing systems and components shall remain fully operational in all occupied spaces during all occupied periods.
- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent finished areas and/or other system components. During cutting and patching operations, protect adjacent installations. Remove protection and barriers after demolition operations are complete.

3.2 WORK IN EXISTING SPACES

- A. General: Care shall be taken when working in existing spaces so as not to damage existing walls and ceilings where work is being performed.

- B. Existing Ceilings: Where work is being performed above existing ceilings, and the architectural drawings do not indicate ceiling modifications by the General Contractor, it shall be the responsibility of this contractor to remove and replace existing ceilings where work is being performed. In those instances, all repair and installation of new grid, ceiling panels, etc shall be the responsibility of this contractor. Match existing finishes.
- C. New Ceilings: Where existing air outlets are to remain, and the architectural drawings indicate replacement of the ceilings, this contractor shall temporarily remove air outlets, clean and store temporarily. This contractor shall support existing run outs to structure to facilitate replacement of ceiling. This contractor shall re-install existing air outlets at previous locations and extend run outs to air outlets after new ceiling is installed. Refer to architectural drawings for all required ceiling replacements. Coordinate with all trades prior to re-installation.
- D. Walls & Floors: It shall be the responsibility of this contractor to patch existing walls and floors and match existing finishes where work is being removed or installed and patching is being performed, unless noted otherwise on the architectural drawings.
- E. HVAC Units: Replace all air filters in all HVAC equipment serving renovated space prior to turning space over to owner.
- F. If asbestos, PCB's, or other hazardous materials are encountered in the course of the work, stop work in the vicinity of such materials and report their presence to the Owner. Owner will arrange for proper removal and disposal of hazardous materials.

3.3 GENERAL DEMOLITION

- A. Provide complete mechanical demolition as required for all systems throughout all project areas not indicated to be salvaged or saved. Unless specifically noted otherwise on plans or determined otherwise during this contractor's pre-demolition survey, all abandoned existing mechanical work in the project areas shall be disconnected and removed in its entirety by the Mechanical Contractor. All related work shall comply with the notes specified herein.
- B. Provide demolition work as required to clear and remove all existing mechanical work to be abandoned and as required to accommodate all new work of all trades. In general, remove existing related ductwork, piping, control media, etc. back to nearest concealed accessible terminal or take-off "upstream". Extend ductwork, piping, etc. as required to accommodate new or relocated mechanical work.
- C. Remove abandoned, inactive and obsolete equipment, ductwork, piping, etc. Abandoned work embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove all abandoned materials above accessible ceilings.
- D. Perform cutting and patching required for demolition in accordance with the contract documents.
- E. All abandoned ductwork and piping shall be removed and capped back to respective sources, even if sources are outside of the confines of the project area. Coordinate all work carefully with Owner prior to beginning any mechanical demolition work.

- F. All ductwork, piping, etc. conflicting with construction related work of any and all trades shall be removed and/or relocated by the Mechanical Contractor as necessary and/or as directed by Owner's representative in the field. Mechanical disconnections (and/or reconnections) for equipment to be removed (and/or relocated) shall be by the Mechanical Contractor. This shall apply to all existing mechanical work whether shown on drawings or not.
- G. All refrigerant evacuations and reclaim shall be required for demolished or relocated equipment.
- H. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- I. Provide new work as required to accommodate relocations, etc. Routing of all new ductwork and piping in existing buildings shall be held tight to structure above wherever possible and shall be approved by owner's representative prior to installation.

3.4 DISPOSITION OF REMOVED EQUIPMENT & MATERIALS

- A. If required to accommodate construction related activities, remove and reinstall any conflicting fixtures, devices or equipment that are to remain.
- B. All abandoned materials removed during demolition and thereafter shall be referred to the Owner's representative for disposal instructions. All materials which the Owner elects to retain shall be neatly stored at the site by the Mechanical Contractor as designated by the Owner's representative. All materials which the Owner elects not to retain shall be disposed of by the Mechanical Contractor in a lawful manner.
- C. All fixtures, devices or equipment designated for salvage (removal and reuse, or for turning over to Owner) shall be disconnected and removed undamaged. Disconnect all pigtails, etc. from equipment terminal points and carefully transport and neatly store same to a protected on-site storage location as directed in field.
- D. Components to be reused shall be cleaned (inside and out) and reinstalled where indicated on drawings. Modify and/or extend related existing ductwork and/or piping as required.
- E. Components turned over to Owner shall be neatly stored as groups by system type.

3.5 PRE-EXISTING CODE VIOLATIONS

- A. All existing work which is accessed and/or used under this project shall be inspected and brought into compliance with current codes and standards by the Mechanical Contractor. This shall apply only to the extent that such work is uncovered in the immediate project areas affected by demolition and/or new construction and only to the limited extent that it applies to pre-existing general installation methods (i.e. a missing hanger/support, a missing seal and other minor incidental work).
- B. If more extensive code or safety violations are discovered by the Mechanical Contractor, they shall be immediately brought to the attention (detailed in writing) of the Owner's representative along with the contractors proposed cost for corrections.

3.6 INTERIM LIFE SAFETY WORK

- A. Provide interim fire protection (sprinkler) work in all demolition and construction areas for full code coverage. Further definition will be provided in field if required.

3.7 INTERIM INDOOR AIR QUALITY (IAQ) WORK

- A. All requirements of this IAQ subsection shall be implemented prior to commencement of any demolition/construction activities.
- B. No airborne dust or particulate matter shall be permitted to enter any occupied spaces or any air intakes to existing systems.
- C. Become familiar with all affected HVAC systems to ensure that positive pressure can be maintained, relative to construction areas, in all areas adjacent to construction areas. This shall include all possible operational sequences of all systems such, including operation of smoke control, fire dampers, etc.
- D. All return air and exhaust air terminals within all demolition/construction spaces shall be covered and properly sealed until construction is complete.
- E. All air filters shall be checked at the beginning and end of each work shift and shall be changed in-kind as required to permit free airflow at all times.
- F. Provide temporary exhaust throughout all demolition/construction spaces to ensure proper negative pressure is maintained relative to adjacent areas, including allowances for normal construction traffic through all access doors. Ensure that no windows or doors are left open which could upset the desired negative pressure.
- G. Designate a dedicated qualified person to be on site to monitor all IAQ requirements, including checking filters three to four times per shift, checking for any breeches (by any contractor) such as drilled/cut openings in walls/floors, open windows, etc. Ensure that openings through walls and floors (by any contractor) are made immediately prior to installation of work and properly/permanently sealed immediately thereafter.

END OF SECTION 230505

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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. Metal pipe hangers and supports
 - 2. Trapeze pipe hangers
 - 3. Metal framing systems
 - 4. Thermal-hanger shield inserts
 - 5. Fastener systems
 - 6. Equipment supports
- B. Related Sections:
 - 1. Section 055000.00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Section 232113 "Aboveground Hydronic Piping".
 - 3. Section 233113 "Metal Ductwork" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines to Terminology for Pipe Hangers and Supports"

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified structural professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping, and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Metal pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers including product data for components
 - 2. Metal framing systems including product data for components
 - 3. Equipment supports

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped for hangers in contact with galvanized piping.
 - 3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of steel or stainless steel in moist area.
- B. Copper Pipe Hangers:
 - 1. Nonmetallic Coatings: Plastic coating, jacket, or liner for hangers in contact with copper piping.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Anvil International, Inc.
 - 2. B-Line Systems, Inc. (a division of Cooper Industries)

3. ERICO/Michigan Hanger Company
4. PHD Manufacturing, Inc

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100 psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ERICO International Corporation.
 2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 3. Rilco Manufacturing Co., Inc.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head
 - c. MKT Fastening, LLC
 - d. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc
 - b. ITW Ramset/Red Head
 - c. MKT Fastening, LLC
 - d. Powers Fasteners

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 ROOF EQUIPMENT SUPPORTS

- A. Equipment supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints and integrally formed deck-mounting flange at perimeter.
- B. Support Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Zinc-coated galvanized steel sheet, 0.052 inch thick.
- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Curbs Plus, inc.
 - 2. Pate Company (The)
 - 3. Roof Products, Inc.
 - 4. Thybar Corporation

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
- B. Do not suspend hangers from roof decks. Suspend from roof trusses, joists and joist girders only at panel points and at top chords unless otherwise indicated.

- C. All piping hangers in exterior spaces, such as parking garages, exposure to high humidity, etc., or in interior swimming pool areas shall be galvanized.
- D. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- E. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- F. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- G. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.
- H. Use padded hangers for piping that is subject to scratching.
- I. All mechanical equipment shall have concrete bases and/or structural steel supports and shall be provided by this contractor.
- J. The use of pumps or other equipment as piping supports shall be prohibited. All such connectors and their supports shall be independently supported from the building structure and inspected and approved by the Engineer before bolting.
- K. Piping connections to all equipment with moving parts shall be isolated with braided copper or stainless steel flexible links, which shall be selected to absorb the deflection on the isolating members.
- L. Use thermal-hanger shield inserts for insulated piping and tubing.
- M. Hangers: Provide adjustable, Steel Clevis Hangers (MSS Type 1) for suspension of noninsulated or insulated, stationary pipes.
- N. Horizontal-Piping Clamps: Provide Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3) for suspension of pipes requiring clamp flexibility and up to 4 inches of insulation.
- O. Vertical-Piping Clamps: Provide extension pipe or Riser Clamps (MSS Type 8) for support of pipe risers.
- P. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- Q. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Inserts:
 - a. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Clamps:
 - a. C-Clamps (MSS Type 23): For structural shapes.

- b. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- 3. Miscellaneous:
 - a. Welded Beam Attachments (MSS Type 22): For attaching to bottom of steel beams if loads are considerable and rod sizes are large.
 - b. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - 1) Light (MSS Type 31): 750 lb.
 - 2) Medium (MSS Type 32): 1500 lb.
 - 3) Heavy (MSS Type 33): 3000 lb.
 - c. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - d. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- R. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- S. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- T. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- U. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- V. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- W. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- X. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- Y. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

- Z. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- AA. Install lateral bracing with pipe hangers and supports to prevent swaying.
- BB. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, expansion joints, strainers and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- CC. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- DD. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- EE. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation. Do not exceed pipe stresses allowed by manufacturer.
 - b. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - c. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - d. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Shields:
 - a. Install protective galvanized steel shields, MSS Type 40, on insulated piping smaller than 2-inch NPS. Shields shall span an arc of 180 degrees and shall be a minimum of 12-inches in length.
 - b. Install thermal-hanger shield inserts on all insulated piping 2-inch NPS and larger.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Piping:

Piping Material	Pipe Size	Hanger Spacing (OC)
Steel	NPS 1-1/4" and smaller	8'-0"
Steel	NPS 1-1/2" to NPS 2"	10'-0"
Steel	NPS 2-1/2" and larger	12'-0"
Copper	1" and smaller	6'-0"
Copper	1-1/4" and larger	8'-0"

1. In addition to supported pipe information above, support piping at each change in direction.

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

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 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark Pipe Markers.
 - f. emedco.
 - g. Kolbi Pipe Marker Co.
 - h. LEM Products Inc.
 - i. Marking Services, Inc.
 - j. Seton Identification Products; a Brady Corporation company.
 - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 3. Letter Color: White
 - 4. Background Color: Black
 - 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Carlton Industries, LP.
 4. Champion America.
 5. Craftmark Pipe Markers.
 6. emedco.
 7. Kolbi Pipe Marker Co.
 8. LEM Products Inc.
 9. Marking Services, Inc.
 10. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: White
- D. Background Color: Red
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 DUCT LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Carlton Industries, LP.
 - 4. Champion America.
 - 5. Craftmark Pipe Markers.
 - 6. emedco.
 - 7. Kolbi Pipe Marker Co.
 - 8. LEM Products Inc.
 - 9. Marking Services Inc.
 - 10. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Duct Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Self-Adhesive Duct Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: Size letters at least 1 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
- E. Letter Color: White
- F. Background Color: Varies by duct type. See schedules below.
- G. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

2.4 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Carlton Industries, LP.
 - 4. Champion America.
 - 5. Craftmark Pipe Markers.
 - 6. emedco.
 - 7. Kolbi Pipe Marker Co.
 - 8. LEM Products Inc.
 - 9. Marking Services Inc.
 - 10. Seton Identification Products; a Brady Corporation company.

- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue for cold-air supply ducts.
 - 2. Yellow for hot-air supply ducts.
 - 3. Green for exhaust-, outside-, relief-, return-, and mixed-air ducts.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230566 – SORBENT-BASED INDOOR AIR FILTRATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes factory-packaged and assembled air cleaning equipment modules, to provide gas-phase air filtration for cleaning indoor air contaminants, including Formaldehyde, and other Volatile Organic Compounds (VOCs) in addition to common outdoor air contaminants such as Ozone and fine particulate matter (PM).

1.2.1 SCOPE

- A. section includes specifications for factory fabricated sorbent based indoor air filtration units. Included are the following topics:

- 1. PART 1 – GENERAL
 - a. 1.1 Summary
 - b. 1.2 Scope
 - c. 1.3 Related Sections
 - d. 1.4 Work Included
 - e. 1.5 Definitions
 - f. 1.6 References
 - g. 1.7 Reference Standards
 - h. 1.8 Submittals
 - i. 1.9 Shop Drawings
 - j. 1.10 Quality Assurance
 - k. 1.11 Ratings and Certifications
 - l. 1.12 Project Conditions
 - m. 1.13 Compliance
 - n. 1.14 Coordination
 - o. 1.15 Warranty
 - p. 1.16 Startup
 - q. 1.17 Extra Materials
- 2. PART 2 - PRODUCTS
 - a. 2.1 Manufacturers
 - b. 2.2 Performance
 - c. 2.3 Construction and Components
 - d. 2.4 Accessories
- 3. PART 3 - EXECUTION
 - a. 3.1 Examination
 - b. 3.2 Applications
 - c. 3.3 Delivery, Storage, and Handling
 - d. 3.4 Installation

- e. 3.5 Identification
- f. 3.6 Connections
- g. 3.7 Startup Service
- h. 3.8 Cleaning
- i. 3.9 Field Quality Control
- j. 3.10 Demonstration

1.4 WORK INCLUDED

- A. The mechanical contractor to furnish original equipment as designed, specified, and scheduled. The mechanical contractor to install original equipment as mandated by the submitted and approved Construction Drawings.
- B. The mechanical contractor shall be responsible for coordinating all requirements of the original equipment as published by the manufacturer.
- C. If the mechanical contractor elects to substitute alternate equipment or increase/decrease the quantity of specified original equipment, the altered system shall be resubmitted for review and approval prior to equipment manufacturing release.

1.5 DEFINITIONS

- A. HLR: HVAC Load Reduction
- B. HVAC: Heating, Ventilation, Air-Conditioning
- C. VOC: Volatile Organic Compound
- D. IAQ: Indoor Air Quality
- E. IAQP: Indoor Air Quality Procedure
- F. VRP: Ventilation Rate Procedure
- G. BMS: Building Management System

1.6 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section

1.7 REFERENCE STANDARDS

- A. ASHRAE 52.2 – Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

- B. ASHRAE 145.2 - Laboratory Test Method for Assessing the Performance of Gas-Phase Air-Cleaning Systems: Air-Cleaning Devices
- C. ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality
- D. NFPA 70 – National Electric Code
- E. NFPA 90A – Installation of Air Conditioning and Ventilation Systems
- F. UL-1995 – Standard for Safety for Heating and Cooling Equipment
- G. EN60950-1, CSA Std C22.2 No.113-10 UL507 9th Ed

1.8 SUBMITTALS

A. Information Submittals

- 1. Furnish all product equipment information including drawings indicating unit dimensions, product data, cut sheets, required clearances, field connection locations, unit weights, wiring diagrams, and proper installation configurations. Drawings shall be submitted at scale of 1/4" = 1'-0".
- 2. Report electrical requirements for power supply wiring including wiring diagrams for interlock and controls wiring, clearly indicating factory-installed and field-installed wiring requirements. Report motor electrical characteristics.
- 3. Equipment support submittal, drawn to scale.

B. ASHRAE 62.1 Indoor Air Quality Procedure Compliance Report

- 1. Provide the documentation required by ASHRAE Standard 62.1 – 2022 and relevant addenda. A summary of compliance requirements for the list of design contaminants of concern, design targets, and mixture of compounds.

C. Closeout Documents

- 1. Installation, Operations, and Maintenance (IOM) Manual as published by original equipment manufacturer and revised for applicable installed product.
- 2. Manufacturer technician or factory-trained personnel to provide Equipment Start-Up Report.
- 3. Any revisions made by the Contractor to the conditions or from that shown on the drawings shall be included in an 'As-built' document package.

1.9 SHOP DRAWINGS

- A. Include dimensioned computer-generated unit plans, section views, attachment details, wall and floor penetrations, structural frame design, in locations applicable for equipment module installation.
- B. Shop drawing submittals shall be coordinated with mechanical contractor to ensure feasibility of design and corrected for any altered field conditions not foreseeable by the registered design engineer.
- C. Shop drawings to be used for the purposes of accurate material planning, sizing, ordering, and account for all necessary and predicted field change orders.
- D. Include details of equipment and system assemblies and features. Indicate dimensions, required clearances, and acceptable service space. Include the following:
 - 1. Each installed unit's type, details, and equipment ratings.
 - 2. Nameplate legends and equipment tags.
 - 3. Tabulations of all installed supporting equipment, devices, controllers, and sensors.
- E. Wiring diagram, system block diagram, controls diagram, schematic wiring for all equipment modules and supporting equipment shall be furnished by the contractor.

1.10 QUALITY ASSURANCE

- A. The design indicated on the schedules and shown on the drawings is based upon the in-scope products, herein the original equipment, of the named manufacturer. Alternate equipment or systems are acceptable only if specified/scheduled performance requirements are met and approved by Engineer of Record. Refer to Division 1, General Conditions, Equals and Substitutions.
- B. The units shall be factory assembled and tested per this specification. Each equipment module shall be fully end-of-line tested for proper functioning, including fan operation and correct sensor calibration.

1.11 RATINGS AND CERTIFICATIONS

- A. Unit safety: UL 1995 or CSA C22.2 No.236
- B. Filter media: ANSI/UL 900 listed Class I or Class II
- C. Control wiring: NEC codes & ETL requirements
- D. Air cleaning efficiency: ASHRAE 145.2

1.12 PROJECT CONDITIONS

- A. Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or Operator unless permitted to do so by facility Owner or Operator. Owner, Operator, contractor, or service personnel to follow power or electrical shut-down guidelines and procedures per the manufacturer to avoid potential equipment damage.

1.13 COMPLIANCE

- A. A summary of ASHRAE 62.1-2022 Section 6.3.2 compliance requirements for the list of design compounds (DCs) and design targets and mixture of compounds in the table below (Table 6-5):

COMPOUND OR PM _{2.5}	COGNIZANT AUTHORITY	DESIGN TARGET
Acetaldehyde	Cal EPA CREL (June 2016)	140 ug/m ³
Acetone	AgBB LCI	1,200 ug/m ³
Benzene	Cal EPA CREL (June 2016)	3 ug/m ³
Dichloromethane	Cal EPA CREL (June 2016)	400 ug/m ³
Formaldehyde	Cal EPA 8-hour (2004)	33 ug/m ³
Naphthalene	Cal EPA CREL (June 2016)	9 ug/m ³
Phenol	AgBB LCI	10 ug/m ³
Tetrachloroethylene	Cal EPA CREL (June 2016)	35 ug/m ³
Toluene	Cal EPA CREL (June 2016)	300 ug/m ³
1,1,1-trichloroethane	Cal EPA CREL (June 2016)	1000 ug/m ³
Xylene, total	AgBB LCI	500 ug/m ³
Carbon monoxide	USEPA NAAQS	9 ppm
PM _{2.5}	USEPA NAAQS (annual mean)	12 ug/m ³
Ozone	USEPA NAAQS	70 ppb
Ammonia (only for spaces with animals)	Cal EPA CREL (June 2016)	200 ug/m ³

1.14 COORDINATION

- A. If the original equipment system is supplied by a manufacturer other than the one named, herein alternate equipment, coordinate with the General Contractor and affected subcontractors to ensure the specified performance is met.
- B. The Mechanical Contractor shall be responsible for costs incurred by the General Contractor, Subcontractors, and Consulting Engineers to accommodate equipment and controls furnished by a manufacturer other than the manufacturer named as basis of design.
- C. Coordinate sizes and locations of concrete bases with actual equipment provided.
- D. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.15 WARRANTY

- A. Provide original equipment parts warranty for 12 months from date of shipment. The warranty shall cover manufacturer defects, and manufacturer agrees to replace components of units that fail in materials or workmanship within the specified warranty period. Warranty work shall be performed by the manufacturer's factory-trained representatives or manufacturer-employed technicians.
- B. Annual Service and Service Agreements and details therein are NOT included or covered by the Warranty (Standard only).
- C. The manufacturer or Manufacturer's Representative shall submit sample warranty for special warranty offerings to be purchased by and approved by the new equipment owner.

1.16 STARTUP

- A. Do not operate units for any purpose, temporary or permanent, until installation is completed in compliance with manufacturer's start-up requirements to ensure safe and correct operation and integrity of warranty.
- B. Factory-trained or factory-provided service technicians are required to start-up and commission units upon the complete installation of the equipment and supporting systems. Upon start-up completion, technician personnel to draft a commissioning document and provide it to equipment Owner or Operator to indicate satisfactory system installation and operation.
- C. Provide all manuals, instructions, Startup Checklist, and all quality assurance documents directly to Owner and/or Operator.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. enVerid Systems, Inc. HVAC Load Reduction (HLR®) Module(s).
- B. Original Equipment Manufacturer (OEM) rebranded equivalent.
- C. Approved equipment alternates (prior written approval or consent by Engineer of Record is required). Equipment Alternate must meet the below Performance criteria detailed herein.

2.2 PERFORMANCE

- A. Indoor air quality performance shall comply with ASHRAE 62.1-2022 and relevant addenda via the Indoor Air Quality Procedure (IAQP).

- B. Air Cleaning System cleaning efficiencies shall comply with ASHRAE Standard for Gas Phase Filtration: ASHRAE Standard 145.2 – 2011. Per ASHRAE 62.1-2022 Addendum N, single pass removal efficiencies shall be provided for all relevant contaminants of concern under the scope of the project.
- C. Air Cleaning System shall be certified as zero-byproduct emitting by 3rd Party Certified Lab. Zero-byproduct certification letter required to be submitted to Engineer of Record and equipment Owner and/or Operator.
- D. Mechanism for air cleaning shall be capture and release; air cleaning system alternates shall not alter the chemistry or composition of airborne gaseous substances. Alternate air-manipulative or catalytic type cleaners shall not be approved (i.e. plasma cleaners, ionizers, etc.)
- E. System shall have PM2.5 cleaning efficiency as verified by ASHRAE Standard 52.2 Lab Test by certified 3rd Party Lab. Original Equipment provider to furnish certified efficiency report to Engineer of Record and equipment Owner and/or Operator.
- F. System shall have Ozone (O3) removal efficiency as verified by ASHRAE Standard 145.2 Lab Test by certified 3rd Party Lab. Original Equipment provider to furnish certified efficiency report to Engineer of Record and equipment Owner and/or Operator.
- G. System shall not emit Ozone and/or Reactive Oxygen Species (ROS) of any kind; processes and mechanisms that emit ozone/ROS or have the potential to emit ozone or ROS are not acceptable.
- H. Gas-phase cleaning efficiencies must meet the following minimums for single-pass air cleaning of the following contaminants of concern:

GASEOUS CONTAMINANTS	DESIGN TARGET	FILTER REMOVAL EFFICIENCY (%)
Acetaldehyde	140 µg/m ³	99%
Acetone	1200 µg/m ³	99%
Benzene	3 µg/m ³	87%
Dichloromethane	400 µg/m ³	54%
Formaldehyde	33 µg/m ³	99%
Naphthalene	9 µg/m ³	87%
Phenol	10 µg/m ³	60%
Tetrachloroethylene	35 µg/m ³	54%
Toluene	300 µg/m ³	52%
1,1,1-trichloroethane	1000 µg/m ³	54%
Xylene, total	500 µg/m ³	60%
PM _{2.5} /Particulate Matter	12 µg/m ³	MERV 11
Ozone	70 ppb	70%

2.3 CONSTRUCTION AND COMPONENTS

- A. Filter Bank: The filter bank shall house filters that contain the sorbents used to capture molecular level contaminants during the adsorption (cleaning) process.

- B. Fan: Integrated DC brushless motor driven fan shall control airflow through the unit. The fan motor shall contain on-board locked rotor protection to prevent damage to the unit in the event of motor failure or the fan becomes blocked or locked in position.
- C. Power Requirements: The unit shall be designed to work with single-phase AC power and should accommodate a range of line voltages and frequencies. Rated incoming line-voltage shall be 208V/277V/230V, Single Phase, 60/50 Hz frequency.

2.4 ACCESSORIES

- A. Original Equipment manufacturer shall furnish all sorbent filter sets as separately shipped line-item. First-time loading of filter set shall occur AFTER construction and installation of original equipment. Full set of sorbent filters shall be included in first capital purchase of equipment price. Additional replacement sorbent filter sets shall be executed per the signed service agreement.
- B. Spare parts are NOT included in manufacturer scope but shall be furnished by the contractor per the manufacturer's recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine all areas, surfaces, and sub-surfaces to receive Equipment Modules for compliance with requirements, installation tolerances, and other field conditions that may affect performance.
- B. Examine roughing-in for supporting mechanical and electrical systems to verify actual locations of connections before physical equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been approved and corrected.

3.3 DELIVERY, STORAGE, AND HANDLING

- A. Comply with original equipment manufacturer's instructions for storing, rigging, unloading, and transporting units. Protect units from physical damage. Leave factory-shipping covers in place until installation.
- B. Protect, pack, and secure loose-shipped items within the units. Include detailed packing list of loose-shipped items, including illustrations and instructions for application.
- C. Protect, pack and secure controls devices and other electronic equipment. Do not store electronic equipment in wet or damp areas even when it is sealed and secured.
- D. Seal all openings to protect against damage during shipping, handling and storage.

- E. Wrap units with a tight sealing membrane. Wrapping membrane shall cover entire equipment module, including electrical components, for protection against rain, snow, wind, dirt, sun fading, road salt/chemicals, rust and corrosion during shipping and storage. Cover all equipment, regardless of size or shape and keep clean and dry. Alternatively, equipment modules must be tarped for shipment and storage.
- F. Store per manufacturer's written recommendations. Store equipment modules indoors in a warm, clean, dry place where units will be protected from weather, construction traffic, dirt, dust, water and moisture. If units will be stored for more than 6 months, follow manufacturer's instructions for long-term storage.
- G. Clearly mark with unit tag number. Securely affix safety-warning labels.
- G. Modules shall ship vertically in a sturdy box strapped to a pallet. Inside the box, there must be corner protectors and foam blocks on the top to protect the unit. Shipping and handling warning labels must be affixed on the outside of the box.
- H. Immediately report to shipping handler, manufacturer's representative, or original equipment manufacturer, if damage is observed on the exterior of the packaging, including the "tip-and-tell" indicator to confirm unit and/or packaging was harmed during transport. Document all areas of concern using combination of photographs and handwritten comments to ensure record damage history.

3.4 INSTALLATION

- A. Install equipment per industry standards, applicable codes, and manufacturer's instructions.
- B. Do not put the equipment modules into temporary use prior to complete inspection and startup performed per this specification.
- C. Rigging and material handling of units shall be conducted according to manufacturer's explicit instructions.
- D. Install equipment modules with manufacturer's recommended clearances for access and service. Failure to abide clearance requirements will void proper equipment operation and ability for maintenance personnel to safely perform service to the unit(s). Please refer to the IOM or manufacturer's Design Guide for clearance requirements.

3.5 IDENTIFICATION

- A. Identify and tag all equipment modules, supporting components, and necessary integrated devices. In addition to the equipment label, include a label on the ceiling grid where the unit will be accessed.

3.6 CONNECTIONS

- A. Mechanical and electrical installation connections shall be specified in other Divisions or Sections.

3.7 STARTUP SERVICE

- A. Manufacturer's factory-trained or factory-employed service technician shall startup equipment modules.

3.8 CLEANING

- A. Clean equipment module(s) unit interior prior to operation. Remove all tools, debris, dust, and dirt.
 - 1. Please note, molecular air-cleaning devices are highly sensitive to oversized particulate matter, such as dust, dirt, and other macro-molecules. Should the equipment module be exposed to the oversized particles aforementioned either during construction, installation, or operation, the equipment module will be rendered incapacitated due to system clogging.

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections
 - 1. All tests and inspections shall be performed by manufacturer's factory-trained or factory-employed service technician. Perform field tests and inspections according to commissioning document and start-up procedures.
 - 2. Test all mechanical components for each unit including fan motor assemblies, door latches, mechanical switches, and field removable items and internal support structures.
 - 3. Inspect all equipment-based controllers, wiring, components, connections, and installation supporting equipment.
 - 4. Repair malfunctioning units on-site, where possible, and retest to demonstrate compliance and proper functionality.

3.10 DEMONSTRATION

- A. Gage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Equipment Modules.
- B. Refer to manufacturer's published IOM furnish by the manufacturer to detailed maintenance and operating procedures.

END OF SECTION 230566

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualification to perform TAB work.
- F. TDH: Total dynamic head.
- G. UFAD: Underfloor air distribution.

1.3 INFORMATIONAL SUBMITTALS

- A. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- B. Certified TAB reports.
- C. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC, NEBB, or TABB
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by one of the agencies above.
 - 2. TAB Technician: Employee of the TAB specialist and certified by one of the agencies above.

- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
 - 1. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes the following:
 1. Equipment and systems to be tested.
 2. Strategies and step-by-step procedures for balancing the systems.
 3. Instrumentation to be used.
 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.

- h. Ceilings are installed.
- i. Windows and doors are installed.
- j. Suitable access to balancing devices and equipment is provided.

3.4 PREPARATION AND COORDINATION REQUIREMENTS – GENERAL

- A. Shop drawings, submittal data, up-to-date revisions, change orders, and other data required for planning, preparation, and execution of the TAB work shall be provided to the TAB Agency no later than 30 days prior to the start of TAB work.
- B. System installation and equipment startup shall be complete prior to the TAB Agency's being notified to begin.
- C. The building control system shall be complete and operational. The Building Control system (sub)contractor shall install all necessary computers and computer programs, and make these operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.
- D. All test points, balancing devices, identification tags, etc. shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.
- E. Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

3.5 PREPARATION AND COORDINATION REQUIREMENTS – HVAC CONTROLS

- A. Written notice shall be submitted through the General Contractor to the Architect-Engineer stating that the Control System is operating and controlling the HVAC System.
- B. The Contractor/Control (sub)contractor shall have entered all data needed for the TAB Agency to begin work.
- C. The Contractor/Control (sub)contractor shall be available to correct any problems that the TAB Agency may encounter with the systems.
- D. All costs for additional work by the TAB Agency due to the Contractor's failure to comply with the above shall be paid by the Contractor and any subcontractor(s) for HVAC controls.

3.6 PREPARATION AND COORDINATION REQUIREMENTS – MECHANICAL

- A. Written notice shall be submitted through the General Contractor to the Architect stating that the HVAC system is operational and ready for the TAB Agency.
- B. The Contractor/Mechanical subcontractor shall have proved all units operational and all air outlets in the full open position.

- C. The Contractor/Mechanical subcontractor shall be available to correct any problems that the TAB Agency might have with any equipment or systems.
- D. The Contractor/Mechanical subcontractor shall furnish and install any replacement sheaves, pulleys and drive belts required for flow adjustments, as determined by the TAB Agency. Adjustable sheaves shall be selected so that the final adjustment position is in the middle third of the total adjustment range.
- E. All costs for additional work by the TAB Agency due to the Contractor's failure to comply with the above shall be paid by the Contractor and any subcontractor(s) for mechanical work.

3.7 PREPARATION AND COORDINATION REQUIREMENTS – DUCTWORK

- A. Ductwork air leakage testing shall be performed by the TAB Agency.
- B. The ductwork/sheet metal subcontractor shall promptly correct any related problems discovered by the leakage tests.
- C. All costs associated with retesting and/or delays or other problems which impede the TAB Agency from performing such testing shall be paid by the contractor and any subcontractor(s) for ductwork.

3.8 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems ", or ASHRAE 111 for LEED Projects.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.9 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings.

3.10 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.

3.11 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:
 - 1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
 - 2. Verify that the system is under static pressure control.
 - 3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
 - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
 - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
 - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.

- d. Adjust controls so that terminal is calling for minimum airflow.
 - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
 - f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
 - c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 - d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
6. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Balance the return-air ducts and inlets.
 - b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:
 - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
 - b. Re-measure and confirm that total airflow is within design.
 - c. Re-measure final fan operating data, speed, volts, amps, and static profile.
 - d. Mark final settings.
 - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
 - f. Verify tracking between supply and return fans.

3.12 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Phase and hertz.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter size and thermal-protection-element rating.
 - 8. Service factor and frame size.

3.13 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.14 PIPE LEAKAGE TESTS

- A. Witness the pipe pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.15 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.16 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

3.17 FINAL REPORT

- A. Final TAB Report – The TAB Agency shall submit the final TAB report for review by the engineer. All equipment including but not limited to fans, outlets, traverses, static pressure profiles, pumps, coils, etc. shall be identified in the report. The report must also include, at minimum, electronic drawings that correspond to all test points for additional report clarification. The TAB Agency shall submit an “National Project Performance Guarantee” assuring that the project systems were tested, adjusted and balanced in accordance with the project specifications and National Standards.
- B. Submit three (3) electronic copies of the Final TAB Report to the Architect-Engineer, and (1) electronic copy to the Project Manager from the Division of Engineering and Contract Administration. A maximum of three (3) additional hard copies shall be submitted on request.
- C. Payments for the TAB work shall be contingent upon the proper submittal and approval of the TAB reports.

3.18 DEFICIENCIES

- A. Any deficiencies in the installation or performance of a system or component observed by the TAB Agency shall be brought to the attention of the appropriate responsible person. Also notify the mechanical project representative from the Division of Engineering and Contract Administration.
- B. The work necessary to correct items on the deficiency listing shall be performed and verified by the affected contractor before the TAB Agency returns to retest. Unresolved deficiencies shall be noted in the final report.

END OF SECTION 23 05 93

SECTION 23 07 13.00 - DUCT INSULATION

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 insulating the following duct services:
 - 1. HVAC Ductwork.
- B. Related Sections:
 - 1. Section 23 05 03 "Submittals for HVAC".
 - 2. Section 23 31 13 "Metal Ducts".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Schedule: Submit schedule showing insulation products which will be used for each application, indicating thickness, density, and accessories.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application at linkages of control devices.
- D. Schedule: Submit schedule showing insulation products which will be used for each application, indicating thickness, density, installed R-values and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ANSI/ASTM E 84 and NFPA 255, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- C. Installed R-Values for insulation on ducts shall comply with local mechanical and energy code as required for indoor applications.
- D. Insulation tape shall comply with UL 181.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing duct systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION MATERIALS

- A. Manufacturers
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Owens Corning; SOFTR All-Service Duct Wrap.
 - e. ThermaDuct, LLC
- B. Interior (indoor) ductwork insulation shall have a minimum installed thermal resistance value of R6 or code minimum, whichever higher.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. [Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, without facing and with vapor barrier Type II with factory-applied kraft paper, reinforcing scrim, aluminum foil and vinyl jackets.
- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB. For duct and plenum applications, provide insulation without facing and with vapor barrier with factory-applied kraft paper, reinforcing scrim, aluminum foil and vinyl jacket.
- G. Vapor Barrier Material for Ductwork: Paper-backed aluminum-foil, except as otherwise indicated; strength and permeability rating equivalent to factory-applied vapor barriers on adjoining ductwork insulation, where available; with following additional construction characteristics:
 - 1. High Puncture Resistance: Low vapor transmission (for ducts in exposed, high traffic areas susceptible to damage: Mech. Rooms, etc.)
 - 2. Moderate Puncture Resistance: Medium vapor transmission (for ducts in concealed areas).
- H. Ductwork Insulation Accessories: Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- I. Ductwork Insulation Compounds: Cements, mastics, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- C. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.
- D. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated
- E. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed. Duct lining thermal resistance value shall comply with external duct wrap requirements.
- F. Corner Angles: Install corner angles on external corners of insulation on ductwork in exposed finished spaces.
- G. Provide insulation on collar and backside of supply diffusers in all ceiling spaces. Provide insulation on plenum box of all supply grilles and registers in all ceiling spaces.
- H. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- I. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- J. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- K. Install multiple layers of insulation with longitudinal and end seams staggered.
- L. Keep insulation materials dry during application and finishing.
- M. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

- N. Install insulation with least number of joints practical.
- O. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- P. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- S. Do not overly compress insulation which will result in decreased thermal resistance properties. Install insulation as recommended by the insulation manufacturer.
- T. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 DUCT INSULATION SCHEDULE, GENERAL

- A. All ductwork shall be insulated except:
 - 1. Double-Wall duct.
 - 2. Fibrous-glass ducts.
 - 3. Fabric ductwork.
 - 4. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 5. Factory-insulated flexible ducts.
 - 6. Factory-insulated plenums and casings.
 - 7. Flexible connectors.
 - 8. Vibration-control devices.
 - 9. Factory-insulated access panels and doors.
 - 10. Supply ductwork exposed in conditioned spaces excluding mechanical rooms, server rooms and electric equipment rooms.
 - 11. Toilet exhaust, general exhaust and return ductwork in an insulated joist or attic space.
- B. Grilles, Registers, and Diffusers:
 - 1. Provide insulation on collar and backside of supply diffusers in all ceiling spaces. Provide insulation on plenum box of all supply grilles & registers in all ceiling spaces.
 - 2. All Transfer Air ducts shall be provided with acoustic lining unless otherwise noted on drawings.

3.5 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):
Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- C. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 PROTECTION AND REPLACEMENT

- A. Repair damaged vapor barrier using vapor barrier tape to fully cover torn area.
- B. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- C. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 07 13.00

SECTION 23 31 13 - METAL DUCTWORK

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. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and flat-oval ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.
- B. Related Sections:
 - 1. Section 23 05 01 "Common Requirements for HVAC".
 - 2. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.

10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Ductwork Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dixie Sheetmetal
 - b. Eastern Sheetmetal of Cincinnati
 - c. Lindab
 - d. Semco Mfg., Inc.
 - e. Hranec
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
- B. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
 8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 3 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Base: Synthetic rubber resin.

3. Solvent: Toluene and heptane.
 4. Solids Content: Minimum 60 percent.
 5. Shore A Hardness: Minimum 60.
 6. Water resistant.
 7. Mold and mildew resistant.
 8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 9. Service: Indoor or outdoor.
 10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations.

Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF DUCT LINER

- A. General: Install duct liner in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
- B. Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if lined duct is used.
- C. Store internally lined ductwork up off of the floor. Protect internally lined ductwork from water and dust.
- D. Shop Application of Duct Liner:

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
- E. Inspect and repair all damaged lining prior to installation of ductwork.
- F. The following ductwork shall be lined:
1. Return from open ceiling plenum return to HVAC unit.
 2. Transfer Air ducts.
- G. The following ductwork shall be lined with flexible duct liner:
1. Exhaust ductwork 10 feet upstream and downstream of fans.
 2. Transfer air ducts.

3.3 DUCT SEALING

- A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 4. Unconditioned Space, Exhaust Ducts: Seal Class C.
 5. Unconditioned Space, Return-Air Ducts: Seal Class B.
 6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 8. Conditioned Space, Exhaust Ducts: Seal Class B.
 9. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. All ductwork required to be painted shall be cleaned and oil-free. Mechanical Contractor shall prepare ductwork surfaces accordingly to accept primer and paint.
- B. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 09 91 23 "Interior Painting."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - c. Return Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - e. Outdoor Air Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 DUCT CLEANING

- A. Clean existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.

- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 6. Provide drainage and cleanup for wash-down procedures.
 - 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

- A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Motor Operated Dampers
 - 3. Flange connectors.
 - 4. Turning vanes.
 - 5. Flexible connectors.
 - 6. Flexible ducts.
 - 7. Duct accessory hardware.
- B. Related Requirements:
 - 1. Section 23 05 03 "Submittals for HVAC".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Motor operated damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Duct security bars.
 - f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

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

1.6 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.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.

5. Pottorff.
 6. Ruskin Company.
 7. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 3000 fpm.
- D. Maximum System Pressure: 3-inch wg.
- E. Frame: Hat-shaped, 0.063-inch- thick extruded aluminum, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, 0.050-inch- thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked.
- I. Blade Axles:
1. Material: Aluminum.
 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- K. Bearings: Bearings shall be dustproof ball type for low pressure operation.
- L. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
 2. Counterweights and spring-assist kits for vertical airflow installations.
 3. Electric actuators.
 4. Chain pulls.
 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 6. Screen Mounting: Inlet.
 7. Screen Material: Aluminum.
 8. Screen Type: Bird.
 9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Ruskin Company.

- f. Vent Products Company, Inc.
 - g. Greenheck Fan Corporation.
 2. Standard leakage rating.
 3. Suitable for horizontal or vertical applications.
 4. For units less than 36" wide or 12" high
 - a. Frame shall be 22 gage galvanized steel.
 - b. Blade shall be single skin, 22 gage galvanized steel with center "V" groove for reinforcement.
 - c. Bearings shall be corrosion resistant synthetic sleeve type turning in an extruded hole in the damper frame.
 - d. Axles shall be 3/8" square shaft positively locked into damper blade.
 5. For units over 36" wide and 12" high
 - a. Frame shall be 18 gage galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement.
 - b. Blades shall be single skin 18 gage galvanized steel with three longitudinal grooves for reinforcement.
 - c. Bearings shall be corrosion resistant synthetic sleeve type turning in an extruded hole in the damper frame.
 - d. Axles shall be hexagonal positively locked into damper blade.
- B. Jackshaft:
 1. Size: 1-inch diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.5 MOTOR OPERATED DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Pottorff.
 5. Ruskin Company.
 6. Vent Products Company, Inc.
- B. All louvers, gravity roof ventilators, etc. shall have motor operated dampers. Dampers shall be low leak with blade and edge seals.
- C. All motor operated dampers shall be furnished and installed by the mechanical contractor. All damper actuators shall be furnished, installed and wired by the TCC, unless damper & actuator are provided by equipment manufacturer. TCC shall provide all necessary transformers,

contactors, controls and wiring for interlocking equipment to motor operated dampers. Frames shall be 5" x 1" x 0.081" minimum thickness, 6063T5 extruded aluminum hat channel with hat mounting flanges on both sides of the frame. Each corner shall be reinforced with two die formed internal braces and machine staked for maximum rigidity.

- D. Blades shall be airfoil type galvanized steel with integral structural reinforcing tube running full length of each blade. Blade edge seals shall be extruded vinyl double edge design with inflatable pocket which enables air pressure from either direction to assist in blade to blade seal off. Blades seals shall be mechanically locked in extruded blade slots, yet shall be easily replaceable in field. Adhesive or clip-on type blade seals are not acceptable.
- E. Bearings shall be non-corrosive molded synthetic. Axles shall be square to provide positive locking connection to blades and linkage. Round axles are not acceptable. Linkage shall be concealed in frame.
- F. All dampers shall be tested in accordance with AMCA 500 and shall be rated AMCA Class 1A for 3.5 cfm/sf at 1" wg pressure for all sizes 24" wide and above.
- G. Dampers shall be parallel blade for 2-position control and opposed blade for modulating control.
- H. Provide electrical disconnect switch for all electric damper actuators.
- I. Motor operated dampers wired to emergency power shall have spring loaded normally closed actuators.

2.6 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Eastern Sheetmetal.
 - 3. Nexus PDQ; Division of Shilco Holdings Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aero Dyne.
 - 2. Ductmate Industries, Inc.
 - 3. Duro Dyne Inc.

4. Elgen Manufacturing.
 5. METALAIRE, Inc.
 6. SEMCO Incorporated.
 7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.8 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Flexmaster U.S.A., Inc.
 3. Greenheck Fan Corporation.
 4. McGill AirFlow LLC.
 5. Ruskin.
 6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Continuous hinge and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Continuous hinge and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous hinge and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts. Factory set at 3.0- to 8.0-inch wg.

3. Doors close when pressures are within set-point range.
4. Hinge: Continuous piano.
5. Latches: Cam.
6. Seal: Neoprene or foam rubber.
7. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.9 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Elgen Manufacturing.
 4. Ventfabrics, Inc.
 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.

2.10 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
 4. Insulation R-value: Comply with local ASHRAE/IESNA 90.1 requirements.
- C. Flexible Duct Connectors:
 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches, to suit duct size.

2.11 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install motor operated dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel. These dampers, whether shown on the drawings or not, shall be installed at no additional cost to the Owner. Consult with Testing, Adjusting, and Balancing Agency prior to ductwork installation to establish damper locations.
 - 1. Install steel dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. At outdoor-air intakes and mixed-air plenums.
 - 2. Downstream from manual volume dampers, motor operated dampers, backdraft dampers, and equipment.
 - 3. Upstream and downstream from turning vanes.
 - 4. Control devices requiring inspection.
 - 5. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
 2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment. The use of flexible connectors as a means of duct transitions is prohibited.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- P. Connect flexible ducts to metal ducts with draw bands.
- Q. Maximum length of flexible branch duct shall not exceed five feet and only be used at air devices.
- R. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00

SECTION 23 34 23.00 - HVAC POWER VENTILATORS

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. Centrifugal roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.

2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards:
1. Power ventilators shall comply with UL 705.

1.9 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of roof curbs, equipment supports and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Manufacturing Corporation.
 2. Breidert Air Products.
 3. Greenheck Fan Corporation.
 4. Loren Cook Company.

- B. Housing: Provide the Following Types of Housing Design:
 - 1. spun-aluminum, dome top and outlet baffle
- C. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Curb Seal: Provide rubber seal between fan and curb to assure proper sealing when attached to curb.
- E. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- F. Accessories:
 - 1. Variable-Speed Controller (direct drive fans): Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Disconnect Switch: Provide NEMA 3R, nonfusible type, with thermal-overload protection factory mounted outside fan housing, factory wired through an internal aluminum conduit.
 - a. For single phase fractional HP fans use a toggle type disconnect switch.
 - b. For three phase integral HP fans use a NEMA 3R safety switch.
 - 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 4. Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops. Damper motor shall be 120V/1 phase unless otherwise noted. Provide local disconnect switch
- G. Roof Curbs: Provide factory fabricated roof curb by the same manufacturer as the equipment. Roof curb to be insulated.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system.
 - 5. Adjust damper linkages for proper damper operation.
 - 6. Verify lubrication for bearings and other moving parts.
 - 7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 9. Shut unit down and reconnect automatic temperature-control operators.
 10. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- C. Lubricate bearings.

END OF SECTION 23 34 23.00

SECTION 23 36 00 - AIR TERMINAL UNITS (VAVs)

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. Single-duct air terminal units.
- B. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:
 - 1. Power all 277 volt power and low voltage wiring for all VAV boxes including wiring to controllers, actuators, valves, dampers, etc. from power source to power connections. Provide transformers and low voltage wiring to all devices.
 - 2. Provide new circuit breaker(s) in spare(s) at panel board with 277 volt wiring to all transformers. Include transformers, disconnects and required electrical devices.
 - 3. Provide all control wiring between field-installed controls and air terminals.
- C. Refer to Division 26 for the following work; not work of this section:
 - 1. Power supply wiring for electric heat and fans.
- D. Related Sections:
 - 1. Section 23 05 01 "Common Requirements for HVAC".

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports and/or seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems"
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.

- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment, seismic restraints and vibration isolation.
 - 4. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
- C. Delegated-Design Submittal:
 - 1. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 2. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.
- D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- C. Comply with ARI 880 standard for terminal boxes
- D. Comply with ARI 410 standard for reheat coils.
- E. Identification: Provide label on each unit indicating Plant Number, CFM Range, CFM factory setting, and calibration curve (if required).

PART 2 - PRODUCTS

2.1 SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Price Industries.
 2. Titus.
 3. Trane; a division of Ingersoll Rand
 4. Carrier
 5. Enviro-Tec
- B. Configuration: Diverting-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: Construct of 22 gauge galvanized sheet metal. Provide airtight gasket and quarter turn latches. Provide hanger brackets for attachment of supports.
1. Casing Lining: Complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. [Provide ½" fiber-free Liner (engineered polymer foam liner)]
 2. Air Inlet: Round stub connection for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Sound Power Levels: Provide sound power levels not exceeding the following:

	Radiated:	Discharge Sound:
a. 2nd octave:	65	68
b. 3rd octave:	60	68
c. 4th octave:	55	65
d. 5th octave:	49	60
e. 6th octave:	40	57
f. 7th octave:	34	57
g. NC:	30	28

- E. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Access door interlocked disconnect switch.
 2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 3. Nickel chrome 80/20 heating elements.
 4. Airflow switch for proof of airflow.
 5. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 6. Mercury contactors.
 7. Pneumatic-electric switches and relays.
 8. Magnetic contactor for each step of control (for three-phase coils).
- F. Controls General: each VAV air terminal shall be equipped with the following:
1. Control enclosure for controller mounting.

2. Each terminal shall have both discharge air temperature and supply CFM sensors
 3. Temperature Control Contractor shall furnish and field install DDC Controls for boxes.
- G. Electronic Controls: Bidirectional damper operator and microprocessor-based thermostat. Control devices shall be compatible with temperature controls specified in Section 23 09 00 "Instrumentation and Control for HVAC" and shall have the following features:
1. Damper Actuator: 24 V, powered closed, powered open.
 2. Thermostat: Wall-mounted electronic type with the following features:
 - a. Temperature set-point display in Fahrenheit and Celsius.
 - b. Auxiliary switch to energize heating control circuit.
 - c. Changeover thermistor to reverse action.
- H. Control Sequence: Integrate terminal units into existing Building Automation System.
- I. Accessories: Provide the following access panel accessories:
1. Removable panel to fully access heating coil
 2. Quarter turn screw latch

2.2 HANGERS AND SUPPORTS

- A. Comply with section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment".
- B. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- C. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- D. Steel Cables: Galvanized steel complying with ASTM A 603 (for standard installation) and Stainless steel complying with ASTM A 492 (for installation in corrosive environments).
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install temperature control devices including but not limited to wall mounted sensors and/or thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Connect ducts to air terminal units according to Section 23 31 13 "Metal Ducts."
- C. Make connections to air terminal units with flexible connectors complying with requirements in Section 23 33 00 "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Perform tests and inspections per manufacturer's instructions and recommendations.
- C. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air terminal unit will be considered defective if it does not pass tests and inspections.
- E. Prepare written test and inspection reports. Identify any discrepancies in operation and/or performance. Provide recommendations.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 23 36 00

SECTION 23 37 13 – HVAC DIFFUSERS, REGISTERS, AND LOUVERS

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. Rectangular and square ceiling diffusers.
 - 2. Linear slot diffusers.
 - 3. Fixed face registers and grilles.
- B. Related Sections:
 - 1. Section 23 05 01 “Common Requirements for HVAC”.
 - 2. Section 23 07 13 “Duct Insulation”.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Rectangular and Square Ceiling Diffusers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Krueger.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Price Industries.
 - g. Titus.
 - h. Tuttle & Bailey.
 - i. Warren Technologies.
 2. Devices shall be specifically designed for variable-air-volume flows.
 3. Material: Aluminum
 4. Finish: Baked enamel, white.
 5. Face Size: 24 by 24 inches.
 6. Face Style: Plaque.
 7. Mounting: Surface or T-bar.
 8. Pattern: Adjustable.
 9. Dampers: Butterfly in drywall applications. Not required if equalizing grid is provided.
 10. Accessories:
 - a. Equalizing grid.
- B. Supply Registers and Grilles
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. METALAIRE, Inc.
 - d. Nailor Industries Inc.
 - e. Price Industries.
 - f. Titus.
 - g. Tuttle & Bailey.
 - h. Warren Technologies.
 2. Devices shall be specifically designed for variable-air-volume flows.
 3. Material: Steel or Aluminum in moist areas such as locker rooms and shower areas.
 4. Finish: Baked enamel, white.
 5. Face Size: On Drawings
 6. Mounting: Surface or T-bar.
 7. Pattern: Adjustable core style.
 8. Dampers: Butterfly.
 9. Accessories:
 - a. Square to round neck adaptor.
 - b. Adjustable pattern vanes.
 - c. Throw reducing vanes.
 - d. Equalizing grid.
 - e. Plaster ring.
 - f. Safety chain.
 - g. Wire guard.
 - h. Sectorizing baffles.
 - i. Operating rod extension.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Slot Diffuser

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Krueger.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Price Industries.
 - g. Titus.
 - h. Tuttle & Bailey.
 - i. Warren Technologies.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Shell: Steel or Aluminum in moist areas such as locker rooms and shower areas.
4. Material - Pattern Controller and Tees: Aluminum.
5. Finish - Face and Shell: Baked enamel, black.
6. Finish - Pattern Controller: Baked enamel, black.
7. Finish - Tees: Baked enamel, white.
8. Slot Width: See drawing schedules.
9. Number of Slots: See drawing schedules.
10. Length: On Drawings
11. Insulated plenum boot.
12. Accessories: Plaster frame, T-bar slot. See architectural reflected ceiling plan for mounting type.

2.3 REGISTERS AND GRILLES

A. Fixed Face Grille

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company
 - b. Carnes
 - c. Krueger
 - d. Nailor Industries Inc.
 - e. Price Industries
 - f. Titus
 - g. Tuttle & Bailey.
 - h. Warren Technologies.
2. Material: Steel or Aluminum in moist areas such as locker rooms and shower areas.
3. Finish: Baked enamel, white.
4. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
5. Core Construction: Integral.
6. Frame: 1-1/4 inches wide.
7. Mounting: Concealed.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. LEED Submittals:
 - 1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 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. Filters: One set(s) for each air-handling unit.

1.7 QUALITY ASSURANCE

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

- B. ASHRAE Compliance:

- 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."

- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period:

- a. For Compressor: One year(s) from date of Substantial Completion.
 - b. For Parts: Five year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers
 - 1. Trane
 - 2. Carrier
 - 3. LG
 - 4. Mitsubishi
 - 5. JCI
 - 6. Daikin

2.2 INDOOR UNITS (5 TONS (18 kW) OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
 - 1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
 - 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 - 3. Fan: Direct drive, centrifugal.
 - 4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Enclosure Type: Totally enclosed, fan cooled.
 - c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - e. Mount unit-mounted disconnect switches on interior of unit.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

- A. Air-Cooled, Compressor-Condenser Components:
 - 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
 - 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Inverter.

- b. Inverter compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
- c. Refrigerant Charge: R-32
- d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid sub-cooler. Comply with ARI 206/110.
- 3. Fan: Aluminum-propeller type, directly connected to motor.
- 4. Motor: Permanently lubricated, with integral thermal-overload protection.
- 5. Low Ambient Kit: Permits operation down to 0 deg F for cooling operation.
- 6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
 - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."
 - 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
 - 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- D. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 260010 – GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS

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.
- B. The Instructions to Bidders, General and Special Conditions, and all other contract documents shall apply to the Contractor's work as well as to each Sub Contractor's work. Each Contractor is directed to familiarize themselves in detail with all documents pertinent to this Contract. In case of conflict between these General Provisions and the General and/or Special Conditions, the affected Contractor shall contact the Engineer for clarification and final determination.
- C. Each Contractor shall be governed by any alternates, unit prices and Addenda or other contract documents insofar as they may affect their part of the work.

1.2 SUMMARY

- A. Section Includes general requirements applicable to work specified in Divisions 26, 27, and 28.
- B. The work included in this division consists of the furnishing of all labor, equipment, transportation, supplies, material and appurtenances and performing all operations necessary for the satisfactory installation of complete and operating Electrical Systems indicated on the drawings and/or specified herein.
- C. Any materials, labor, equipment or services not mentioned specifically herein which may be necessary to complete or perfect any part of the Electrical Systems in a substantial manner, in compliance with the requirements stated, implied, or intended in the drawings and specifications, shall be included as part of this Contract. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in their bid, and that they will be responsible for the approved satisfactory functioning of the entire system without extra compensations.
- D. It is not the intent of this section of the specifications (or the remainder of the contract documents) to make any specific Contractor, other than the Contractor holding the prime contract, responsible to the Owner, Architect and Engineer. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be done through the Contractor to the Architect (if applicable), then to the Engineer.
- E. This section of the Specifications or the arrangement of the contract documents shall not be construed as an attempt to arbitrarily assign responsibility for work, material, equipment or services to a particular trade Contractor or Sub-Contractor. Unless stated otherwise, the

subdivision and assignment of work under the various sections shall be the responsibility of the Contractor holding the prime contract.

- F. Any reference within these specifications to a specific entity, i.e., "Electrical Contractor" is not to be construed as an provide to limit or define the scope of work for that entity or assign work to a specific trade or contracting entity. Such assignments of responsibility are the responsibility of the Contractor holding the prime contract, unless otherwise provided herein.
- G. In each of the specifications and drawings referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.
- H. Intent and Interpretation
 - 1. It is the intent of these specifications and all associated drawings that the Contractor provide finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete, tested and ready for operation."
 - 2. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.
 - 3. It is the intention of the Contract Documents to call for a complete and operational system, including all components, accessories, finish work, etc. as necessary for trouble free operation; tested and ready for operation. Anything that may be required, implied, or inferred by the Contract Documents shall be provided and included as part of the Bid.
 - 4. All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
 - 5. The Bidder/Proposer shall completely review the Contract Documents. Any interpretation as to design intent or scope shall be provided by the Engineer/ Architect. Should an interpretation be required, the Bidder/Proposer shall request a clarification not less than ten days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event of any conflict, discrepancy, or inconsistency develops; the interpretation of the Engineer shall be final.
 - 6. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in the bid, and that will be responsible for the approved satisfactory functioning of the entire system without extra compensations.
- I. Drawings and Specifications
 - 1. The drawings are diagrammatic only and indicate the general arrangement of the systems and are to be followed insofar as possible. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted in writing to the Engineer for approval before proceeding with the work. The Contract Drawings are not intended to show every vertical or horizontal offset which may be

- necessary to complete the systems. Contractors shall, however, anticipate that additional offsets may be required and submit their bid accordingly.
2. The drawings and specifications are intended to supplement each other. No Contractor, bidder, proposer or supplier shall take advantage of conflict between them, or between parts of either, but should this condition exist, the Contractor or supplier shall request a clarification of the condition at least ten days prior to the submission of bids so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be the determining factor. In all instances, unless modified in writing and agreed upon by all parties thereto, the Contract to accomplish the work shall be binding on the affected Contractor.
 3. The drawings and specifications shall be considered to be cooperative and complimentary and anything appearing in the specifications which may not be indicated on the drawings or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
 4. This Contractor shall make all their own measurements in the field and shall be responsible for correct fitting. They shall coordinate this work with all other branches of work in such a manner as to cause a minimum of conflict or delay.
 5. The Engineer shall reserve the right to make minor adjustments in location of conduit, fixtures, outlets, switches, etc., where they consider such adjustments desirable in the interest of concealing work or presenting a better appearance.
 6. Each Contractor shall evaluate ceiling heights called for on Architectural Plans and ensure that these heights may be maintained after all mechanical and electrical equipment is installed. Where the location of Electrical equipment may interfere with ceiling heights, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work on the part of the Contractor or unduly delay the work.
 7. Should overlap of work between the various trades become evident, this shall be called to the attention of the Engineer. In such an event, neither trade shall assume that he is to be relieved of the work which is specified under his branch until instructions in writing are received from the Engineer.
 8. The Electrical drawings are intended to show the approximate location of equipment, materials, etc. Dimensions given in figures on the drawings shall take precedence over scaled dimensions and all dimensions whether given in figures or scaled shall be verified in the field. In case of conflict between small- and large-scale drawings, the larger scale drawings shall take precedence.
 9. The Electrical Contractor and their Sub-Contractors shall review all drawings in detail as they may relate to his work (structural, architectural, site survey, mechanical, etc.). Review all drawings for general coordination of work, responsibilities, ceiling clearances, wall penetration points, chase access, fixture elevations, etc. Make any pertinent coordination or apparent conflict comments to the Engineers at least ten days prior to bids, for issuance of clarification by written addendum.
 10. Where on any of the drawings a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornament or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.

1.3 COST BREAKDOWN AND PAY APPLICATIONS

- A. Within thirty days after acceptance of the Contract, each Contractor is required to furnish to the Engineer one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made on forms provided or approved by the Engineer or Architect. Payments will not be made until satisfactory cost breakdowns are submitted. Refer to Division 00 and 01 specification sections for additional requirements.
- B. In addition to cost breakdowns by specification section, the following shall also be provided: Material and labor shall be listed separately. These items are in addition to items listed in Division 01 specifications. Pay special attention to required withholding percentages for startup, testing, documentation, acceptance, owner training, etc. The breakdown shall be minimally as follows:
1. Permitting
 2. Mobilization
 3. Electrical Submittals
 4. Electrical Coordination Drawings
 5. Temporary Power
 6. Interior Lighting Materials & Labor
 7. Exterior Lighting Materials & Labor
 8. Lighting Controls Materials & Labor
 9. Lighting and Lighting Controls Startup, Testing, & Verification (equal to 2.5% of Equipment Value)
 10. Electrical Distribution Equipment Materials & Labor
 11. Electrical Distribution Equipment Startup, Testing, & Verification (equal to 2.5% of Equipment Value)
 12. Electrical Distribution Equipment Power System Study & Field Adjusting
 13. Feeders Materials & Labor
 14. Branch Circuiting Materials & Labor
 15. Service Grounding Materials & Labor
 16. Surge Suppression Materials & Labor
 17. Electrical Devices Materials & Labor
 18. Cable Trays Materials & Labor
 19. Underground Duct Banks Materials & Labor
 20. Fire Alarm Materials & Labor
 21. Fire Alarm System Startup, Testing, & Verification (equal to 5% of Equipment Value)
 22. Low-Voltage Rough-in Materials & Labor
 23. Low Voltage Systems Startup, Testing, & Verification (equal to 5% of Equipment Value)
 24. Automatic Transfer Switches Materials & Labor
 25. Owner Training
 26. Punchlist
 27. As-Built/Record Drawings
 28. O&M Manuals
 29. Warranty
 30. Demobilization

1.4 REFERENCES

- A. Abbreviations and Acronyms
1. A, AMP: Ampere

2. ADA: Americans with Disabilities Act.
3. AFF: Above Finished Floor
4. AFG: Above Finished Grade
5. AHJ: Authority Having Jurisdiction
6. AHU: Air Handling Unit
7. AIC: Amps Interrupting Capacity
8. ANSI: American National Standards Institute.
9. ASA: American Standards Association.
10. ASTM: American Society for Testing Materials.
11. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers.
12. ATS: Automatic Transfer Switch
13. A/V: Audio/Visual
14. AWG: American Wire Gauge
15. BAS: Building Automation System
16. BFG: Below Finished Grade
17. BICSI: Building Industry Consulting Services International
18. C: Conduit
19. CB: Circuit Breaker
20. CFCI: Contractor Furnished, Contractor Installed
21. CFOI: Contractor Furnished, Owner Installed
22. CKT: Circuit
23. CLG: Ceiling
24. CT: Current Transformer
25. CM: Construction Manager
26. DDC: Direct Digital Building Controls
27. DOAS: Dedicated Outdoor Air System
28. DWG: Drawing
29. EC: Electrical Contractor
30. ELEV: Elevator
31. EM: Emergency
32. EPO: Emergency Power Off
33. FA: Fire Alarm
34. FAA: Fire Alarm Annunciator
35. FACP: Fire Alarm Control Panel
36. FCC: United States Federal Communications Commission
37. FFE: Finished Floor Elevation
38. FLA: Full Load Amps
39. G, GND: Ground
40. GFCI: Ground Fault Circuit Interrupter
41. GC: General Contractor
42. HOA: Hands Off Auto
43. HP: Horsepower
44. IDF: Intermediate Distribution Frame
45. IECC: International Energy Conservation Code
46. ISO: International Standards Organization.
47. IT: Information Technology
48. KVA: Kilovolt-Amperes
49. KW: Kilowatt
50. KWH: Kilowatts Hours
51. LRA: Locked Rotor Amps
52. LTG: Lighting

- 53. MC: Mechanical Contractor
- 54. MCA: Minimum Circuit Ampacity
- 55. MCB: Main Circuit Breaker
- 56. MDF: Main Distribution Frame
- 57. MDP: Main Distribution Panel
- 58. MLO: Main Lugs Only
- 59. MOCP: Maximum Overcurrent Protection
- 60. MSB: Main Switchboard
- 61. N/A: Not Applicable
- 62. NEC: National Electrical Code
- 63. NECA: Standards for Installation.
- 64. NEMA: National Electrical Manufacturers Association.
- 65. NESC: National Electrical Safety Code.
- 66. NFPA: National Fire Protection Association.
- 67. NIC: Not in Contract
- 68. NRTL: Nationally Recognized Testing Laboratory
- 69. NTS: Not to Scale
- 70. N/A: Not Applicable
- 71. OFCI: Owner Furnished, Contractor Installed
- 72. OFOI: Owner Furnished, Owner Installed
- 73. OSHA: Office of Safety and Health Administration.
- 74. P: Pole, Poles
- 75. PC: Plumbing Contractor
- 76. PIR: Passive Infrared
- 77. RFI: Request for Information
- 78. RIO: Rough-in Only
- 79. RM: Room
- 80. SPD: Surge Protection Device
- 81. SS: Stainless Steel
- 82. SWBD: Switchboard
- 83. TIA: Telecommunications Industry Association
- 84. TYP: Typical
- 85. UL: Underwriters Laboratories, Inc.
- 86. UON or UNO: Unless otherwise noted.
- 87. UG: Underground
- 88. V: Volt, Volts
- 89. VFD: Variable Frequency Drive
- 90. W: Watts
- 91. WG: Wire Guard
- 92. WP: Weather Proof
- 93. XFMR: Transformer

B. Definitions

- 1. Architect: The Architect of Record for the project, if applicable.
- 2. Basis of Design (BOD): Documentation of primary thought processes and assumptions behind design decisions made to meet design intent. Describes systems, components, conditions and methods chosen to meet intent.
- 3. Bidder/Proposer: Any person, agency or entity submitting a proposal to any person, agency or entity for any part of the work required under this contract.

4. Contract Documents: All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Manager's Assignments, Architect's Supplemental Instructions, Construction Contract with Owner, etc.
 5. Contractor: Any Contractor whether bidding, proposing or working independently or under the supervision of a General Contractor, Prime Contractor, or Construction Manager and who installs any type of Electrical Work as specified in the Contract Documents.
 6. Electrical Contractor: Any Contractor whether bidding or working independently or under the supervision of the entity holding the Prime Contract and who installs any type of Electrical work, such as: power, lighting, television, telecommunications, data, fiber optic, intercom, fire detection and alarm, security, video, underground or overhead electrical, etc.
 7. Electrical Sub-Contractor: Each or any Contractor contracted to, or employed by, the Electrical Contractor for any work required by the Electrical Contractor.
 8. Engineer: The Consulting Mechanical-Electrical Engineer consulting to the Owner, Architect, or Other, etc.
 9. Indicated: Listed in the Specifications, shown on the Plans or Addenda thereto.
 10. Install: Install equipment furnished by others in complete working order.
 11. Installer: 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.
 12. Furnish: Deliver to the site in good condition and turn over to the Contractor who is to install.
 13. Prime Contractor: The Contractor who has been engaged by the Owner in a contractual relationship to accomplish the work.
 14. Project: All of the work required under this Contract.
 15. Provide: Furnish and install complete, tested and ready for operation.
 16. Start-Up: The activities where systems or equipment are initially tested and operated. Start-up is completed prior to functional testing.
 17. Typical: Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.
 18. Vendor: Supplier of equipment.
- C. Reference Standards: Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. Contractor shall adhere to the most recent revisions or version adopted by the Authorities Having Jurisdiction, including all relevant changes or addenda at the time of installation.
1. IEEE – Institute of Electrical and Electronics Engineers.
 - a. IEEE C2, National Electrical Safety Code
 2. NECA – National Electrical Contractors Association.
 - a. NECA 1, Standard for Good Workmanship in Electrical Construction
 3. NFPA - National Fire Protection Association.
 - a. NFPA 70, National Electrical Code (NEC)
 4. OSHA - The Occupational Safety and Health Act

1.5 COORDINATION

A. Utility Company Requirements

1. Utility feeds for power and telecommunications are existing to remain.

B. Coordination with Existing Utilities and Structures

1. The locations of all piping, conduits, cables, utilities, and manholes existing, or otherwise, that are present within the contract construction site, shall be subject to continuous uninterrupted maintenance with no exception unless the Owner of the utility grants permission for temporary interruption.
2. Known utilities and structures as available to the Engineer are shown on the drawings. However, it is additionally required that, prior to any excavation being performed, each Contractor ascertain and mark all utilities or lines that would be endangered by the excavation. Contractor shall bear costs of repairing damaged utilities.
3. If utilities or structures are installed within the construction project boundary, the Contractor shall first probe and make every effort to locate the lines prior to excavating in the respective area.
4. Cutting into existing utilities and services shall be done in coordination with and as designated by the Owner of the utility. The Contractor shall work continuously to restore service(s) upon deliberate or accidental interruption, providing premium time and materials as needed without extra claim to the Owner.
5. The Contractor shall repair to the satisfaction of the Engineer any surface or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.
6. Machine excavation shall not be permitted within ten feet of existing gas or fuel lines. Hand excavate only in these areas, in accord with utility company, agency or other applicable laws, standards or regulations.
7. Protect all new or existing lines from damage by traffic, etc. during construction.
8. Protect existing trees, indicated to remain with fencing or other approved method. Hold all new subsurface lines outside the drip line of trees, offsetting as necessary to protect root structures. Refer to planting or landscaping plans, or in their absence, consult with the Architect.

C. Interruption of Existing Services: In general, and to the extent possible, perform all work without interruption of the existing facilities' operations. Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify the Owner, Architect, and Engineer no fewer than seven days in advance of proposed interruption of service.
2. Provide the exact time the interruption will occur and the length of the interruption.
3. Do not proceed with interruption of service without written permission from Owner, Architect, and Engineer.
4. Failure to comply with this requirement may result in complete work stoppage by the Contractors involved until a complete schedule of interruptions can be developed.
5. Contractor will not be entitled to additional compensation due to work stoppage mandated by unscheduled interruption.
6. Coordinate interruptions with systems impacted by outages including but not limited to the following:
 - a. Generators
 - b. Medium voltage paralleling Gear
 - c. Emergency Lighting

- d. Elevators
 - e. Fire Alarm Systems
7. Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore the service. The Contractor shall provide tools, materials, skilled journeymen of their own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without requests for extra compensation to the Owner, except where otherwise provided for in the contract for the work.

D. Coordination Between Trades

- 1. The Contractor is expressly directed to read the General Conditions and all detailed sections of these specifications for all other trades and to study all drawings applicable to their work, including Architectural, Mechanical, Structural and other pertinent Drawings, to the end that complete coordination between trades will be affected.
- 2. The Contractor is responsible for the correct location of all rough-in and connections at every piece of equipment. Work not correctly located shall be relocated at the Contractor's expense.
- 3. It shall be the responsibility of each Contractor to leave the necessary room for other trades. No extra compensation or time will be allowed to cover the cost of removing fixtures, devices, conduit, ducts, etc. or equipment found encroaching on space required by others.
- 4. Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than $\frac{1}{4}$ inch = 1 Foot, clearly indicating how his work is to be installed in relation to the work of other trades, or so as not to cause any interference with work of other trades. The Contractor shall make the necessary changes in his work to correct the condition without extra charge.
- 5. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

E. Temporary Services

- 1. The Contractor shall arrange for temporary electrical and other services required to accomplish the work. In the absence of other provisions in the contract, the Contractor shall provide for temporary services of all types, including the cost of connections, utility company fees, construction, removal, etc., in their bid.
- 2. All temporary services shall be removed by Contractor prior to acceptance of work.

F. Temporary Use of Equipment

- 1. The permanent electrical equipment, when installed, may be used for temporary services, subject to an agreement among the Contractors involved, the Owner, and with the consent of the Engineer. Should the permanent systems be used for this purpose, each Contractor shall pay for all temporary connections required and any replacements required due to damage without additional cost to the Owner, leaving the equipment and installation in "as new" condition. The Contractor may be required to bear utility costs, user fees, etc.
- 2. Permission to use the permanent equipment does not relieve the Contractors who utilize this equipment from the responsibility for any damages to the building construction and/or equipment which might result from its use.

G. Preinstallation Conference

1. Conduct a preinstallation conference at project site before each construction activity when required by other Sections and when required for coordination with other construction.
2. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Engineer of scheduled meeting dates.
3. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including any possible conflicts, requirements, limitations, and coordination with other work.
4. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
5. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
6. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date

1.6 SUBMITTALS

- A. Review of submittals by the Engineer applies only to conformance with the design intent of the project and general compliance with the information given in the contract documents. In all cases, the installing Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.
- B. The Engineer's review of submittals, schedules or other required submittal data shall not relieve the Contractor from responsibility for the adaptability of the equipment or materials to the project, compliance with applicable codes, rules, regulations, information that pertains to fabrication and installation, dimensions and quantities, electrical characteristics, and coordination of the work with all other trades involved in this project.
- C. If a submittal deviates from the drawings or specifications because of Contractor's standard practice, approved substitution request, or any other reason, the submittal shall notify the designer of the deviation.
- D. Prior to the start of work the contractor shall submit the following. Work shall not proceed without the Engineer's and Owner's completed review of the submitted items.
- E. 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. Clearly and precisely mark red notations and yellow highlights on the 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. Rated capacities, operating characteristics, and electrical characteristics,
 - i. Wiring diagrams that show factory-installed wiring and interface points.
 - j. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 4. Format and Organization: submit bookmarked electronic PDF files complying with the following:
 - a. Cover: Clearly display the following information: Owner name, Project name, Submittal name, project submittal number, Contractor name and contact information, and applicable specification section numbers.
 - b. Table of Contents: Include a TOC that lists materials by section number, with a brief product description, manufacturer and part number, and list the submittal page number per product
 - c. Product Information
- F. Product Schedules: 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:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.
 - 4. Location within room or space.
- G. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
 - 1. Shop Drawings that are reproductions of the Contract Documents are not permitted and will be rejected.
 - 2. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Mounting Details
 - c. Wiring diagrams and installation details
 - 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. Seal and signature of professional engineer if specified.
- H. Coordination Drawings:
 - 1. Detailed electronic coordination drawings shall be required for this project. The Engineer and the Engineer's Construction Administrator shall closely monitor progress and quality of the preparation of the electronic coordination drawings and may withhold pay requests as deemed appropriate.

2. Coordination Drawings shall be provided on this project by each Trade. Drawings shall be 30x42 sheet size and shall be at 1/4-inch scale and shall match the drawing setup as included in the Architectural Drawings. Drawings shall be prepared in electronic format utilizing Revit and Navisworks software. The Architect and Engineer will supply electronic drawings files of the Contract Documents upon the Contractor's request and release.
3. The basis for the Coordination Drawings shall be the sheet metal ductwork fabrication shop drawings, all electrical feeder conduits, groupings of branch circuit conduits, other conduits 2" and larger, and pneumatic tube system piping and components in ceiling spaces. These drawings shall indicate all ductwork as double lined with bottom elevations noted. The Coordination Drawings shall indicate:
 - a. Systems above ceilings in finished areas,
 - b. Systems supported from the structure in finished areas without ceilings,
 - c. Systems in the mechanical rooms, and
 - d. All wall, roof, floor penetrations.
4. For branch circuit coordination electrical contractor shall detail all areas down to 3/4" where conduits are grouped together.
 - a. This needs to be considered for all areas of the project.
 - b. This can be identified as a zone for running conduits in lieu of individual conduits.
 - c. Any junction box locations should be identified to confirm no conflicts.
5. The sheet metal fabrication shop drawings shall be completed in a timely manner so as not to conflict with construction schedule and phasing plan. At the Prime Contractor's discretion, these drawings shall be completed in phases to correspond with the project construction work sequencing. The Mechanical Contractor shall furnish an electronic copy of these ductwork shop drawings to all other Trades, specifically the Fire Protection and Electrical and other Contractors as requested by the Prime Contractor for the purpose of including other trades work on the Coordination Drawings.
6. Pre-Coordination Meetings with all necessary trades shall occur. During these meetings, the Contractors shall discuss locations/elevations where piping, conduits, cable path, etc. will be installed with respect to the sheet metal fabrication drawings and other trades. The sheet metal ductwork and gravity piping systems shall be given the first priority. Within 30 days of the meeting, each Trade shall provide the Mechanical Contractor electronic drawings of all of their systems (with elevation noted), coordinated with the ductwork and other trades for them to incorporate into the Coordination Drawings. Coordination Meetings shall then occur so that all conflicts can be resolved between Trades. All conflicts shall be resolved between all Trades at these Coordination Meetings and the Mechanical Contractor shall then amend the Drawings to include the Final Coordinated Work.
7. It is realized that not all systems can be completely detailed. The coordination drawings shall include the following at a minimum:
 - a. All supply/return/exhaust ductwork.
 - b. All above slab sanitary and roof drainage piping.
 - c. HVAC, fire protection and domestic water piping which are 2" in size and greater, excluding insulation.
 - d. Gas mains.
 - e. Electrical conduits which are 1.5" in size and greater.
 - f. J-hook and cable tray cabling paths
 - g. Groupings of smaller piping/conduits hung on a common hanger.
 - h. All wall, roof, floor penetrations.
 - i. Light fixtures.
8. After completion of the Final Coordination Drawings, a Final Review with the all Trades shall occur to provide any final comments and approval by all Trades. Other interim coordination meeting will be required to ensure successful coordination drawings. Any

- additional coordination items will be updated by the Mechanical Contractor. The Final Approved Coordination Drawings shall be distributed electronically (on CD) to each Trade by the Mechanical Contractor. The Mechanical Contractor shall also furnish a complete 30x42 paper set of drawings to the jobsite main office and shall utilize them for updates of field conditions/deviations that occur during construction. Final Approved Coordination Drawings shall also be distributed to the Construction Manager, Owner, Architect and Engineer for their Records. This process shall be completed prior to starting any work.
9. Each Contractor shall ensure that any deviations from the Coordination Drawings are recorded as they occur, in red erasable pencil on record drawings kept at the jobsite. Upon completion of a particular phase, the Mechanical Contractor shall incorporate all field deviations into the Coordination Drawings to be utilized as Record Drawings. The Engineer shall review the Record Documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose. The Record Drawings shall be distributed electronically (on CD) to the Construction Manager, Owner, Architect and Engineer for their Records.
 10. The Mechanical Contractor is responsible to the Prime Contractor for the shop drawing layout of the following rooms and details:
 - a. Concrete pads and foundations
 - b. Equipment room layouts with actual equipment
 - c. Roof layouts
 - d. Trench locations and sizes
 - e. Dimensioned floor drain locations
 - f. Congested areas above ceilings adjacent to mechanical and electrical rooms
 - g. Dimensioned ductwork shop drawings
 11. The Electrical Contractor is responsible to the General Contractor for the shop drawing layout of the following rooms and details:
 - a. Concrete pads and foundations
 - b. Equipment room layouts with actual equipment
 - c. Routes of feeder conduits and all other conduits 1.5" and larger
 - d. J-hook and cable tray cabling paths
 - e. Trench locations and sizes
 - f. Congested areas above ceilings adjacent to mechanical and electrical rooms
 - g. Refer to Part 41 for additional requirements.
 - h. Light fixture locations
 - i. Exact layouts of all work in open ceiling areas
 12. The Construction Manager shall submit an MEP Coordination Schedule to the A/E prior to commencement of work that outlines the schedule, meeting cadence, meeting agendas, coordination process, shop drawing process.
 13. The A/E shall attend a maximum of one (1) MEP coordination meeting per week for time period to be negotiated.
 14. One (1) day prior to each MEP coordination meeting, the Construction Manager shall submit an open item list to the A/E of all coordination items that require design coordination input during the weekly identified coordination meeting attended by the A/E. The Construction Manager shall be prepared to provide potential solutions to each coordination item request to help facilitate resolution of each given item.
 15. Coordination questions and responses shall be tracked by the Construction Manager. The A/E will not duplicate MEP coordination responses in different formats. For example, if a coordination item is submitted and resolved as part of the MEP coordination process, a follow up RFI shall not be issued which requires another response from the A/E.

16. The design team shall not be required to update contract documents to reflect all coordination revisions into a formal construction change order, unless a coordination item is anticipated to affect a permit or field inspection issue.
 17. In the case that the Construction Manager proposes a deviation from the design intent that requires a redesign and update to the contract documents for permitting, inspections, or otherwise, the A/E shall be reasonably compensated for the labor incurred to complete the change.
 18. It shall be the Construction Manager's responsibility to track all coordination changes as part of the As Built Drawing process. Refer to Closeout Procedures and Record Drawing requirements elsewhere in the Project Specifications.
- I. 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.
- J. Closeout Submittals
1. Upon substantial completion of the project, provide a minimum of three bound copies with complex index and tabs to locate each item described below along with digital copy in PDF format on USB storage media.
 2. As-Built Record Documentation
 - a. The Contractor shall insure that any deviations from the design are being recorded daily, as necessary, on record drawings being maintained by the Contractor. Dimensions from fixed, visible permanent lines or landmarks shown in vertical and horizontal ways shall be utilized. Compliance shall be a requirement for final payment. Pay particular attention to the location of underfloor or underground exterior in-contract or utility-owned or leased service lines, main switches and other appurtenances important to the maintenance and safety of the Electrical System. Deliver these record drawings to the Engineer as a system is completed, within ten days of the mark-up and/or while the accuracy of the mark-ups can be verified visually. Monthly payment may be withheld if the requirement is not complied with.
 - b. All underground utilities/piping installed as part of this project shall be surveyed by a land surveyor licensed in the State where the Work is being performed. This shall include underground electrical primary, communications, and structures. The survey shall include actual duct bank depths to top of conduit every 100 feet in length. The survey shall also include benchmarks dimensions relative to above grade, fixed structures. The survey shall be furnished on electronic storage media in AutoCad ".dwg" format and ".pdf" format. The survey information shall be included in the closeout documentation.
 - c. Refer to additional record drawing requirements within the general conditions and other sections of these specifications.
 3. Start-Up and System Testing Certificates
 - a. Provide reports from all required testing to indicate procedures followed and complete results of all tests. Provide reports on manufacturer's standard forms for all equipment and system tests. Testing reports shall indicate applicable NEC, NFPA, UL, NETA, and/or ANSI standards.
 4. Operation and Maintenance Manuals
 - a. Provide operation and maintenance instructions and parts lists for all equipment provided in this contract. Formatting and content shall follow the guidelines outlined in the latest version of ASHRAE Application Handbook, Guideline.

- b. All instructions shall be submitted in draft, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
- c. The operation and maintenance document directory should provide easy access and be well organized and clearly identified.
- d. The operation and maintenance manuals shall contain the following information:
 - 1) Emergency information should be immediately available during emergencies and should include emergency and staff and/or agency notification procedures.
 - 2) Provide contacts (company name, address, phone number, email) where parts may be purchased for each principal item of equipment.
 - 3) Provide detailed maintenance instructions, including recommended preventative maintenance schedules for all equipment requiring maintenance. For lighting and lighting controls, provide recommended driver replacement schedule, provide a schedule for inspecting and recalibrating lighting controls, and provide a recommended settings list for all components with adjustable settings.
 - 4) General Information. Provide the following:
 - a) Building function
 - b) Building description
 - c) Operating standards and logs
 - 5) Technical Information. Provide the following:
 - a) System description
 - b) Operating routines and procedures
 - c) Seasonal start-up and shutdown
 - d) Special procedures
 - e) Basic troubleshooting
 - 6) Equipment data sheets. Provide the following:
 - a) Vendor and local representative's contact information
 - b) Operating and nameplate data
 - c) Warranty
 - d) Detailed operating instructions.
 - e) Tools required
 - f) Types of cleaners to use
 - 7) Maintenance program information. Provide the following:
 - a) Manufacturer's installation, operation, and maintenance instructions
 - b) Spare parts information
 - c) Preventive maintenance actions
 - d) Schedule of actions
 - e) Action description
 - f) History
 - 8) Test reports document observed performance during start-up and commissioning.
 - 9) Reference Division 01 specifications for additional requirements.
- e. Shop drawings will not be accepted as satisfying the requirement for Operation and Maintenance Manuals.
- f. Submittals: Provide complete copies of all reviewed submittals. Where submittals were returned "Furnish as Corrected", the contractor shall make the corrections noted by the engineer and submit final corrected shop drawings with close-out documentation.

- g. Parts List: Provide an inventory of all spare parts, special tools, attic stock, etc. that have been provided to the owner.
- 5. Warranty Documentation: Provide all documentation and certificates related to Contractor's warranty and all other specific manufacturer's warranties indicated in the construction documents.
- 6. Training Verification: Provide certification that all specified training has been completed. List training session dates, times, and types. Include any session materials and recordings.
- 7. Inspection Certificates: Provide certificates of inspection from electrical inspector, fire marshal, and any other required special inspections.
- 8. Reports and System Certifications: Provide final reports and any system certifications required in other specification sections.
- 9. Power Riser Diagram: Provide a framed and mounted full-size copy of the overall power riser diagram (under glass) to the Owner. Also, provide three vinyl-coated copies of same. Where an existing power riser diagram is present, the Contractor shall obtain the document from the Owner, and update in digital format with the scope of this project. Edits shall be in digital format and this work shall be closely coordinated with the Owner.
- 10. Software and Firmware Operational Documentation: Provide documentation, including the following:
 - a. Software operating and upgrade manuals.
 - b. Names, versions, and website addresses for locations of installed software.
 - c. Device address list.
 - d. Printouts of software application and graphic screens.
- 11. Software Back-ups: Provide software back-ups on USB media that is clearly and permanently labeled and provided with lanyard to prevent misplacement.

1.7 MAINTENANCE MATERIAL

- A. Spare Parts and Extra Stock Material
 - 1. Parts and Materials shall be properly marked and packaged for long term storage.
- B. Special Tools and Keys:
 - 1. Provide, along with the equipment provided, any special wrenches or tools necessary to dismantle or service equipment or appliances.
 - 2. Wrenches shall include necessary keys, handles and operators for valves, switches, breakers, etc. and keys to electrical panels, emergency generators, alarm pull boxes and panels, etc.
 - 3. Provide at least two of any such special wrench, keys, etc. to the Owner prior to completion of the project. Obtain a receipt that this has been accomplished and forward a copy to the Architect and Engineer.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years unless otherwise approved.
 - 1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar.

Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.

2. Equipment shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

B. Installer Qualifications

1. All Electrical Contractors bidding this project must have been a licensed company for a minimum of three years to qualify to bid this project. Individual employee experience does not supersede this requirement.
2. All subcontractors bidding the electrical work must have completed one project of 70 percent this subcontract cost size and two projects of 50 percent this subcontract cost size.
3. All electrical work shall be accomplished by qualified workers competent in the area of work for which they are responsible. Untrained and incompetent workers as evidenced by their workmanship shall be relieved of their responsibilities in those areas. The Engineer shall reserve the right to determine the quality of workmanship of any worker and unqualified or incompetent workers shall refrain from work in areas not satisfactory to them. Requests for relief of a worker shall be made through the normal channels of responsibility established by the Architect or the contract document provisions.
4. All electrical work shall be accomplished by Journeymen electricians under the direct supervision of a licensed Electrician.
5. Special electrical systems, such as Fire Alarm Systems, Telecommunications or Data Systems, Video Systems, Special Electronic Systems, Control Systems, etc., shall be installed by workers normally engaged or employed in these respective trades. Refer to Divisions 27 and 28 for additional requirements.

- C. Licensed Professional Engineer Qualifications: Professional Engineer possessing active qualifications in accordance with Division 01 and licensed by the State in which the Work is being performed.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver or install indoor equipment until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above equipment is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 FIELD CONDITIONS

A. Ambient Conditions:

1. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.

1.11 WARRANTIES

- A. Contractor Warranty: Contractor shall unconditionally guarantee all equipment, apparatus, materials, and workmanship entering into this Contract to be the best of its respective kind and shall replace all parts at their own expense, which fail or are proven defective within one year from Substantial Completion of the work by the Engineer. The effective date of completion of the work shall be the date each or any portion of the work is accepted by the Architect, Engineer, and Owner's Statement of Substantial Completion.
- B. Manufacturer Warranty: Items of equipment which have longer guarantees, as called for in these specifications or as otherwise offered by the manufacturer shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall in no way invalidate the guarantee except that the Owner shall be liable for any damage to equipment during this period due to negligence of his operator or other employee.
- C. The Warranties specified herein and other Sections shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.

1.12 INDEMNIFICATION

- A. The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

1.13 HAZARDOUS MATERIALS

- A. The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building(s). Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of their work, ensure their workers are aware of this potential and what they are to do in the event of suspicion. The Contractor shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall insure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.
- B. CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling or disposal of such material.

- C. If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner immediately.
- D. The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.

1.14 COMMISSIONING

- A. An independent third-party Commissioning Agent will document completion of the Electrical Systems. The Construction Manager and Division 26 Contractor(s) are members of the Commissioning Team and will facilitate completion of the Commissioning process. Refer to Section 019113 Building Systems Commissioning for the project Commissioning requirements and roles and responsibilities of each member of the Commissioning Team.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency suitable to the AHJ, and marked for intended location and application.
- B. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.
- C. Standard Products
 - 1. Except where specifically noted otherwise, all equipment supplied by the Contractor shall be the standard products of a single manufacturer of known reputation and experience in the industry.
 - 2. Only equipment, components and accessories in current production for at least five years beyond the completion date of this system shall be used and installed. Any equipment found to be obsolete or not in future production will be removed and replaced at Contractor's expense. This includes all equipment, materials and labor.
 - 3. Products manufactured more than 2 years prior to date of delivery to site shall not be used, unless specified otherwise.
- D. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Engineer in writing prior to ordering the material and performing installation work.

2.2 PRODUCT SUBSTITUTIONS

- A. Conform to the substitutions requirements and procedures outlined in Division 01.
- B. One substitution for each product specified will be considered and substitutions must be submitted to Engineer a minimum of 10 days prior to bid using the standard CSI substitution request form.
- C. If prevailing laws of cities, towns, states or countries are more stringent than these specifications regarding such substitutions, then those laws shall prevail over these requirements.
- D. Where products are noted as "or equal", a product of equivalent design, manufacture, and performance will be considered. Submit product data (product information, catalog cut sheets, test data, etc.) to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance.
- E. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the contract documents are used to establish standards of quality, utility and appearance and shall not be construed as limiting competition. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when "or equal" follows the manufacturers' names or model number(s).
- F. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.
- G. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the specifications.
- H. Contractor shall pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on their work or other Contractor's work.
- I. In all cases where substitutions affect other trades, the Contractor offering such substitutions shall advise all such Contractors of the change and shall reimburse them for all necessary changes in their work. Any Drawings, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Review of Shop Drawings by the Engineer does not absolve the Contractor of this responsibility.
- J. Contractor shall be responsible and assume all costs for removal and replacement of any substituted product installed without prior written approval. Such costs shall include, but not be limited to labor, materials as well as any penalties, fees or costs incurred for late completion.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Supervision of Work: Each Contractor and Sub-Contractors shall personally supervise the work or have a competent superintendent on the project site at all times during progress of the work, with full authority to act in matters related to the project.
- B. Conduct of Workmen: The Contractor shall be responsible for the conduct of all workmen under their supervision. Misconduct on the part of any workmen to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt relief of that workman. The consumption or influence of alcoholic beverages, narcotics or illegally used controlled substances on the jobsite is strictly forbidden. Possession of a fire-arm is prohibited and may result in prosecution. Foul or bad language, graffiti is strictly prohibited.
- C. No tobacco use, including smokeless tobacco, is allowed on property.
- D. Refer to general conditions documents for badging, and parking requirements.

3.2 EXAMINATION

- A. Each Contractor shall inform themselves of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work. All Contractors shall carefully examine all Drawings and Specifications and inform themselves of the kind and type of materials to be used throughout the project and which may, in any way, affect the execution of their work.
- B. Each Contractor shall fully acquaint themselves with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of temporary or permanent utilities, etc. The Contractor shall include in their work all expenses or disbursements in connection with such matters and conditions. Each Contractor shall verify all work shown on the drawings and conditions at the site, and shall report in writing to the Engineer ten days prior to bid, any apparent omissions or discrepancies in order that clarifications may be issued by written addendum. No allowance is to be made for lack of knowledge concerning such conditions after bids are accepted.

3.3 PREPARATION

- A. Surveys, Measurements, and Grades
 - 1. The Contractor shall lay out their work and be responsible for all necessary lines, levels, elevations and measurements. They must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from their failure to do so.
 - 2. Base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.

3. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, they shall notify the Engineer through normal channels of job communication and shall not proceed with his work until they have received instructions from the Engineer.

3.4 INSTALLATION

- A. At no time shall the contractor work on energized electrical equipment. Contractor shall comply with NFPA 70E requirements at all times throughout construction.
- B. Permits and Fees
 1. The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, and other costs in connection with their work. As necessary, the Contractor shall file all required plans, utility easement requests and drawings, survey information on line locations, load calculations, etc., prepare all documents and obtain all necessary approvals of all utility and governmental departments having jurisdiction; obtain all required certificates of inspection for their work and deliver same to the Engineer before request for final acceptance and final payment for the work.
 2. Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.
- C. Codes and Regulations
 1. The Contractor shall include in the work, without extra cost, any labor, materials, services, apparatus or drawings required in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on drawings and/or specified.
 2. All materials furnished and all work installed shall comply with the adopted edition of the National Electrical Codes, National Fire Codes of the National Fire Protection Association, the requirements of local utility companies, and with the requirements of all governmental agencies or departments having jurisdiction.
 3. All electrical work is to be constructed and installed in accordance with plans and specifications which have been approved in their entirety and/or reflect any changes requested by the AHJ, as applicable or required. Electrical work shall not commence until such plans are in the hands of the Electrical Contractor.
 4. The Contractor shall insure their work is accomplished in accord with OSHA Standards and any other applicable government requirements.
 5. Where conflict arises between any code and the contract documents, the code shall apply except in the instance where the plans and specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten working days prior to bid date, otherwise the Contractor shall make the required changes at their own expense. The provisions of the codes constitute minimum standards for wiring methods, materials, equipment and construction and compliance therewith will be required for all electrical work, except where the drawings and specifications require better materials, equipment, and construction than these minimum standards, in which case the drawings and specifications shall be the minimum standards.
- D. Materials and Workmanship

1. All electrical equipment, materials and articles incorporated in the work shall be new and of equal quality to the specified basis of design. All workmanship shall be first-class and shall be performed by electricians skilled and regularly employed in their respective trades.
2. The Contractor shall determine that the equipment he proposes to furnish can be brought into the building(s) and installed within the space available. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s).
3. All fixtures, devices and wiring required shall be installed to make up complete systems as indicated on the drawings and specified herein.
4. All electrical materials, equipment and appliances shall conform to the latest standards of the National Electric Manufacturers Association (NEMA) and the National Board of Fire Underwriters (NBFU) and shall be approved by the Owner's insuring agency if so required.
5. Comply with National Electrical Contractors Association (NECA) performance standards that are published as National Electrical Installation Standards (NEIS).
6. All applicable equipment and devices provided shall meet all FCC requirements and restrictions.

E. Weatherproofing

1. Where any work penetrates waterproofing, including waterproof concrete, the method of installation shall be as approved by the Architect and/or Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings absolutely watertight.
2. Wherever work penetrates roofing, it shall be done in a manner that will not diminish or void the roofing guarantee or warranty in any way. Coordinate all such work with the roofing installer.

F. Equipment Access

1. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in partitions and above suspended ceilings for the proper installation of their work. Cooperate with the Prime Contractor and all other Contractors whose work is in the same space, and advise each Contractor of equipment requirements. Such spaces and clearances shall be kept to the minimum size required to ensure adequate clearance and access.
2. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include but not be limited to junction boxes, pull boxes, contactors, panels, disconnects, controllers, switchgear, etc. Minor deviations from drawings may be made to allow for better accessibility, and any change shall be approved where the equipment is concealed.
3. Each Contractor shall provide (or arrange for the provision by other trades) the access panels for each concealed junction box, pull box, fixtures or electrical device requiring access or service as shown on Engineer's plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work. All access panels shall be installed in accord with the Architect's standards for such work. In the absence of such specifications, at a minimum such work shall comply with the specifications below. All locations for access panels which are not specifically indicated on the drawings shall be submitted to and approved by the architect prior to ordering.
4. Access Doors; in Ceilings or Walls:
 - a. In mechanical, electrical and service spaces: 14-gauge aluminum brushed satin finish, 1" border.

- b. In finished areas: 14-gauge primed steel with 1" border to accept the architectural finishes specified for the space. Confirm these provisions with the Architect prior to obtaining materials or installing any such work.
- c. In fire or smoke rated partitions, access doors shall be provided that equal or exceed the required rating of the construction they are mounted in.

G. Connections

- 1. Provide rough-in and final connections to all electrically operated equipment furnished under the Work of the contract documents. Carefully coordinate with equipment suppliers, manufacturer's representatives, vendors, and other trades to provide complete electrical and dimensional interface to all equipment.
- 2. Provide all power wiring complete from power source to motor or equipment junction box, including power wiring through starters or contactors. Install all starters not factory mounted on equipment.
- 3. Provide all control, interlock, sensor, thermocouple and other connections required for equipment operation. Coordinate ampacity and voltage characteristics for all motors and equipment.
- 4. Prior to bidding the work, coordinate power, control, sensor, interlock and all other wiring requirements for equipment or motors with all other trades, to ensure all needed wiring is provided. Failure to provide such coordination shall not be justification for claims of extra compensation of a time extension to the Contract.
- 5. At no times shall the contractor work on energized electrical equipment. Comply with NFPA 70E requirements at all times during construction.

- H. Scaffolding, Rigging, and Hoisting: The Contractor shall furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished. All such temporary appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

3.5 RESTORATION

- A. The Contractor shall replace to their original condition all paving, curbing surfaces, drainage ditches, structures, fences, shrubs, existing or new building surfaces and appurtenances, and any other items damaged or removed by his operations. Replacement and repairs shall be in accordance with good construction practice and shall match materials employed in the original construction of the item to be replaced. All repairs shall be to the satisfaction of the Engineer, and in accord with the Architect's standards for such work, as applicable. Patchwork on new construction will not be accepted.

3.6 IDENTIFICATION AND OPERATING INSTRUCTIONS

- A. Provide all equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
- B. Provide operating instructions for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 3. Safety precautions.
 4. The procedure in the event of equipment failure.
 5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.
- C. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

3.7 SYSTEM TESTING, VERIFICATION, AND START-UP

- A. The Contractor (and Sub-Contractors) shall be responsible for starting-up, testing, checking, examining, inspecting, and verifying their systems.
- B. The Electrical Contractor shall designate an individual under their employment to lead the start-up, testing and verification process. This person should not be the project manager or job site superintendent, but a person dedicated to making this critical task successful and completed in a timely manner.
- C. A pre-start-up conference shall be held with the Architect, Owner, Contractors, and the Manufacturer providing startup services. The purpose of this meeting will be to discuss the goals, procedures, etc. for start-up.
- D. The Contractor shall include in the bid to provide systems startup and verification for all electrical systems specified for this project. Specific startup, testing, and verification requirements are included throughout the Electrical specifications. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians (unless noted otherwise) and shall complete and submit start-up reports/checklists. Submit start-up reports to the Engineer. The Contractor shall have appropriate trades on site to correct all deficiencies noted by the factory representative. For each deficiency noted, documentation of corrective action (including date and time) shall be submitted to the Engineer and Owner.
- E. Where manufacturer start-up is not specified for a particular piece of equipment or system, the Contractor shall be responsible to perform start-up in strict accordance with manufacturer's instructions.
- F. The Contractor shall be responsible for completion of a System Verification Checklist (SVC) / Manufacturer's Checklists. Furnish to the Testing Agent and Engineer. Sample checklists shall be submitted to the Engineer, Owner, and Testing Agent for approval.
- G. The completed reports shall be organized and bound together in a tabbed binder and submitted for review and approval.

3.8 FIELD QUALITY CONTROL

A. Inspections

1. Before requesting a final review of the installation from the Architect and/or Engineer, the Contractor shall thoroughly inspect the installation to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineers for unnecessary and undue work on their part.
2. Owner's and Engineer's inspections: Two inspections will be held to generate and then review punchlist items. All site inspections and visits thereafter shall be billed to the Contractor at the Engineer's standard hourly rates.
3. The Contractor shall provide as a part of this contract electrical inspection by a competent Electrical Inspection Agency, licensed to provide such services. The name of this agency shall be included in the list of materials of the Form of Proposal by the Contractor. All costs incidental to the provision of electrical inspections shall be borne by the Electrical Contractor.
4. The Contractor shall advise each Inspection Agency in writing (with an information copy of the correspondence to the Architect and/or Engineer) when they anticipate commencing work. Failure of the Inspection Agency to inspect the work in the stage following and submit the related reports may result in the Contractor's having to expose concealed work not so inspected. Costs associated with any rework, cutting, and patching will be at the expense of the responsible Contractor.
5. Inspections shall be scheduled for rough-in as well as finished work. The rough inspections shall be divided into as many inspections as may be necessary to correct deficiencies. Report of each such inspection visit shall be submitted to the Architect, Engineer and the Contractor within three days of the inspection.
6. Approval by an Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these plans and specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.
7. Before final acceptance, the Contractor shall furnish three copies of the certificates of final approval by the Electrical Inspector (as well as all other inspection certificates) to the Engineer with one copy of each to the appropriate government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.

B. Punch Lists

1. The Contractor shall review each area and prepare a punch list for each of the subcontractors, as applicable, for at least three stages of the project.
 - a. For review of in-wall work that will be concealed by drywall or other materials well before substantial completion.
 - b. For review of the above-ceiling work that will be concealed by tile or other materials well before substantial completion.
 - c. For review of all other work as the project nears substantial completion.
2. When all work from the Contractor's punch list is complete at each of these stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing two weeks prior to the proposed date.
3. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the

Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review.

4. At the engineer's option, the contractor shall supply digital photographs via email or file-share of any installed work.
5. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due 10 days from date of each additional visit) at a rate of \$125.00 per hour for extra trips required to complete either of the above-ceiling or final punch lists.
6. All panelboard fronts shall be removed prior to final punch list inspection and re-installed after completion. Directories for each panelboard shall be completed and available for review by the Engineer at that time.

C. Non-Conforming Work

D. Manufacturer Services

3.9 CLEANING

- A. The Contractor shall, at all times, keep the area of work presentable to the public and clean of rubbish caused by their operations; and at the completion of the work, shall remove all rubbish, all tools, equipment, temporary work and surplus materials, from and about the premises, and shall leave the work clean and ready for use. If the Contractor does not attend to such cleaning immediately upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the responsible Contractor. Each Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of rubbish or debris.
- B. After completion of all work and before final acceptance of the work, each Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of materials, equipment and all associated fabrication. Pay particular attention to finished area surfaces such as lighting fixture lenses, lamps, reflectors, panels, etc.

3.10 TRAINING

- A. Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating all systems and equipment for a period of three days of eight hours each, or as otherwise specified. During this period, instruct the Owner or their representative fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least one week's written notice to the Owner, Architect and Engineer in advance of this period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representative that were present.
- B. Training shall be accompanied by complete as-built documentation and the technical systems operation manual.
- C. The training shall be accomplished by a factory trained representative. Include a minimum of Four hours for each system described here-in unless noted otherwise. Each equipment representative shall be represented wherever their equipment is used.

- D. Demonstration and Training DVDs: These training sessions shall be videotaped by the Installer. Submit two copies within seven days of end of each training module. On each copy, provide an applied label with the following information:
 - 1. Name of Project.
 - 2. Name and address of photographer.
 - 3. Name of Architect and Construction Manager.
 - 4. Name of Contractor.
 - 5. Date video was recorded.
- E. Brochures: Furnish Owner a complete set of operating instructions and diagrams.
- F. Instruction Program: Submit outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- G. At completion of training, submit two complete training manual(s) for Owner's use.
- H. Qualification Data: For facilitator, instructor and photographer.
- I. Attendance Record: For each training module, submit list of participants and length of instruction time.

3.11 PROTECTION

- A. The Contractor shall be entirely responsible for all material and equipment furnished for their work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. Equipment damaged while stored on site either before or after installation shall be repaired or replaced (as determined by the Engineer) by the responsible Contractor. Electrical equipment exposed to the weather shall be replaced by the Contractor at their own expense.

END OF SECTION – 260010

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, and Section 260010 “General Requirements for Electrical Systems” apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Slotted Support Systems.
 - 2. Conduit and Cable Supports.
 - 3. Mounting, Anchoring, and Attachment Components.
 - 4. Fabricated Metal Supports.
 - 5. Concrete Bases.
 - 6. Vibration Isolation pads.
 - 7. Sleeves for penetration of non-fire-rated construction walls and floors.
 - 8. Sleeve-seal systems.
 - 9. Firestopping.
 - 10. Cutting and Patching
 - 11. Painting

1.3 REFERENCES

- A. Abbreviations and Acronyms
 - 1. EMT: Electrical Metallic Tubing.
 - 2. FMC: Flexible Metal Conduit.
 - 3. GRC/GRS: Galvanized Rigid Steel Conduit.
 - 4. LFMC: Liquid-tight flexible metal conduit.
 - 5. RMC: Rigid Metal Conduit
- B. Definitions
 - 1. Channel: A continuous slotted channel (strut) with inturned lips suitable for assembly into multiple configurations
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. Metal Framing Manufacturers Association (MFMA)
 - a. MFMA-4: Metal Framing Standards Publication
 - b. MFMA-103: Guidelines for the use of Metal Framing

1.4 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations with Division 07 Section "Roof Accessories."

1.5 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of components, profiles, and finishes.
 - 2. Include rated capacities.
- B. Shop Drawings: For fabrication and installation details and include calculations for the following:
 - 1. Slotted channel systems.
 - 2. Equipment supports.
 - 3. Concrete Bases for Equipment.
 - 4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: Signed and sealed by a qualified professional engineer. For field assembled or fabricated hangers and supports for electrical systems.
 - 1. Include design calculations and details of trapeze hangers.
- D. Qualification Data: For professional engineer.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to the authority having jurisdiction, and marked for intended location and application.
- B. Delegated Design: Design support systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 SLOTTED SUPPORT SYSTEMS

- A. Description: Preformed, continuous slot, bolted channels with associated fittings and hardware.
 - 1. Available Manufacturers: Subject to compliance with requirements, provide products from one of the following or an approved equal:
 - a. Eaton B-Line.
 - b. Kindorf.
 - c. nVent Caddy.
 - d. Power-Strut.
 - e. SuperStrut.
 - f. Unistrut.
 - 2. Comply with MFMA-4 for factory fabricated components suitable for field assembly.
 - 3. Material and Finish for channel, fittings, and accessories:
 - a. Steel: Minimum 16 gauge, Hot-dip galvanized after fabrication and applied according to ASTM A123 or A153 suitable for indoor or outdoor wet locations.
 - 4. Channel Dimensions: Minimum 1-5/8 inches wide with varying heights and welded combinations selected to meet applicable load criteria.

2.3 CONDUIT AND CABLE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, provide products from one of the following or an approved equal:
 - 1. Eaton B-Line
 - 2. nVent Caddy
 - 3. Thomas & Betts
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Provide plugs with number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported.
- D. Device Box Mounting Brackets: Factory-fabricated sheet steel brackets for support of device boxes adjacent to or between studs.
- E. Through-Stud Cable and Raceway Support Clips: Factory-fabricated spring steel clip for cables or raceways where run horizontally through metal studs.
- F. Roof-mounted Raceway Support Blocking: Non-penetrating, factory-fabricated support blocking for use under roof-mounted raceways. Wedge-shaped blocking constructed of 100% recycled UV-resistant Rubber with integral galvanized steel strut to accept raceway support clips.
- G. Tee Bar Grid Box Hanger: Factory-fabricated metal electrical box hanger for supporting boxes at locations between ceiling system t-grid components. Height adjustable for various electrical box

depths. Attached to ceiling tee bar with screws or integral clamp for stability. Includes tab for independent support wire attachment.

2.4 MOUNTING, ANCHORING, AND ATTACHMENT COMPONENTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton B-Line
 - 2. Empire Industries.
 - 3. Hilti.
 - 4. ITW.
 - 5. MKT Fastening.
- B. Description: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - 2. Concrete Inserts: Steel, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Solid, threaded steel.

2.5 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.6 VIBRATION ISOLATION PADS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Korfund Maxi-Flex Pads or a comparable product by one of the following:
 - 1. Ace Mountings Co.
 - 2. California Dynamics Corporation.
 - 3. Eaton B-Line.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Vibration Eliminator Co.
 - 7. VMC Group
- B. Description: Molded, oil resistant, non-skid elastomeric pads arranged in 2-inch square segments.

- C. Size: Factory or field cut to match requirements of supported equipment.
- D. Load Rating from 120 lbs. up to 360 lbs. per 2-inch segment.

2.7 SLEEVES

- A. Wall and Floor Sleeves:
 - 1. Galvanized Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

2.8 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable. Link Seal system or approved equal.
 - 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: Glass reinforced nylon polymer.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.9 FIRESTOPPING FOR ELECTRICAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following or approved equal:
 - 1. Hilti
 - 2. Specified Technologies Inc (STI)
 - 3. Wiremold
- B. Source Limitations: Obtain firestopping systems through one source from a single manufacturer.
- C. General Requirements:
 - 1. Firestopping systems shall bear UL classification marking corresponding to its Fire Resistance Directory.
 - 2. Comply with testing requirements set forth in ASTM E814 or UL 1479.
 - 3. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
 - 4. Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- D. Fire rated cable pathways: Re-penetrable, maintenance-free cable management devices for use with cable bundles penetrating through fire rated walls or floors.
 - 1. Shall contain a built-in fire sealing system sufficient to maintain the hourly rating of the fire rated wall or floor being penetrated.

2. The system shall adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall firestop materials.
 3. Shall be engineered to allow two or more devices to be ganged together with wall plates for larger cable capacities.
- E. Fire-rated cable grommets: Molded, two-piece grommet with sealing membrane for use with single cables or small bundles at through or membrane wall penetrations.
1. System shall be installed around cables and shall lock tightly into the wall assembly.
- F. Outlet Box Putty Pads: Non-hardening, moldable, intumescent material shaped into preformed pads for use with metallic outlet boxes.
- G. Refer to Division 07 for requirements related to other firestopping systems and materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with manufacturer's installation requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CUTTING AND PATCHING

- A. Unless otherwise indicated, provide cutting and patching necessary to install the work specified. Patching shall match adjacent surfaces to the satisfaction of the Engineer and shall be in accordance with the Architect's standards for such work.
- B. Do not cut structural elements without reinforcing the structure to maintain the designed weight bearing and stiffness. Coordinate approved reinforcement method with Architect and Structural Engineer.

3.3 SUPPORT SYSTEM APPLICATION

- A. Comply with NFPA 70, NECA 1, NECA 101, and MFMA-103 for application of hangers and supports for electrical equipment and systems except where requirements of this Section are more stringent.

- B. Maximum Horizontal and Vertical Support Spacing for Raceway(s): Space supports for raceways as required by NFPA 70.
- C. Minimum Hanger Rod Size for Raceway Supports: 3/8-inch diameter unless noted otherwise.
- D. Single Raceways:
 - 1. For Raceways 1-1/4-inch and smaller: Install adjustable steel band hanger suspended on threaded rod.
 - 2. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/4-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- E. Multiple Raceways and single raceways larger than 1-1/4-inch:
 - 1. Install trapeze-type supports fabricated with slotted support system suspended on threaded rods for horizontal applications and fastened to building structure for vertical applications.
 - 2. Size so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 3. Secure raceways and cables to these supports with two-bolt steel conduit clamps or single-bolt steel conduit clamps using spring friction action for retention in support channel.

3.4 SUPPORT SYSTEM INSTALLATION

- A. Comply with NFPA 70, NECA 1, NECA 101, and MFMA-103 for installation requirements except where requirements of this Article are more stringent.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components multiplied by a safety factor of four with a minimum of 200 lbs.
- C. Mounting and Anchorage of Surface-Mounted or Recessed-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - a. Where support anchors are required, establish their type and locate in concrete construction before concrete is poured. Fit each hanger rod with a nut at its upper end, and set nut in a universal concrete insert in the form. Where supported weight exceeds holding strength of a single insert, pass rods through top slot of inserts and interlock with reinforcing steel. Also, where particularly heavy loads are to be supported, suspend hanger rod or rods from a structural angle spanning two or more inserts and securely bolted thereto to distribute the weight.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Self-drilling concrete anchors or expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
 - 6. To Light Steel: Sheet metal screws.

7. For Surface-Mounted Items on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to structure. Attachment to gypsum wall board is not acceptable as sole support means; slotted-channel rack solidly attached to structure or light-gauge metal framing at both ends is required.
 8. For Recessed-Mounted Items in Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices to intermediate light-gauge metal framing members on each side of device or provide slotted-channel racks within hollow wall attached to structure by means that meet anchorage requirements. Attachment to gypsum wall board is not acceptable as sole support means.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars or existing raceways embedded in slab. Verify reinforcing locations with Structural Engineer and X-Ray existing concrete structures as required.
- E. Do not support any items (equipment, piping, conduit, etc.) exceeding 2 inches in diameter from the bottom of slabs. Where intermediate supports are required between structural members, use slotted steel channels support systems attached to beams or joists in order to avoid attachment to slabs.
- F. Slotted Support Systems
1. Install slotted channel systems level and plumb.
 2. Remove burrs from all exposed cut edges prior to installation.
- G. Wall Stud and Ceiling Supports
1. Fasten junction, pull and devices boxes securely to the building construction, independent of raceway system.
 2. Install Device Box Mounting Brackets supported between two studs. Attach all device boxes to two studs, device box stabilizers are prohibited.
 3. Install Tee Bar Grid Box Hanger supported between two ceiling grid tee bars where devices boxes are located flush in recessed suspended ceilings. Install at least one independent support rod from box hanger to structure.
 4. Install Through-Stud Cable and Raceway Support Clips where cables or raceways run horizontally through metal studs.
- H. Install Roof-mounted Raceway Support Blocking where raceways run on across roofing.
1. Coordinate installation of roof supports with items specified in Division 07 Section "Roof Accessories." Provide products compatible with rooftop materials included in the Work to maintain warranty of roof system.
- I. Threaded Rod Hardware
1. Provide minimum of two lock nuts per threaded support rod except where lock nut tightens against a threaded socket, one locknut may be used.
 2. Trim rod excess to within 1-inch of locknut, de-burr, and provide protective endcap.
- J. Support raceways at a distance above suspended ceilings to permit removal of ceiling panels and luminaires.

- K. Locate raceways and supports so as not to hinder function or code required clearance to any system or equipment.
- L. Provide independent supports and hang all electrical raceways and devices from the building structure with UL listed and approved materials. Utilizing the support systems of other trade's work is prohibited, except with written approval from the Engineer.
- M. Provide riser support clamps for vertical conduit runs and install at each floor level penetration and at additional locations required to support weight of system.
- N. Tighten all bolted connections to proper torque values in accordance with manufacturer's written instructions.
- O. Provide supports to maintain 1/4-inch air space between raceway and mounting surface where raceways are mounted exposed in wet or corrosive locations and where directly attached to concrete or masonry.
- P. The use of tie wire or perforated metal tape for support or fastening of any raceway system is prohibited.
- Q. Where galvanized wire is used for cable supports above suspended ceilings, provide minimum #12 support wire independent of ceiling system secured at both ends. Paint or provide tag to distinguish supports from ceiling system.
- R. Welding directly on raceways, fittings, or outlet boxes is prohibited.

3.5 INSTALLATION OF VIBRATION ISOLATION PADS

- A. Select vibration device load ratings to match equipment loading and deflection criteria.
- B. Arrange pads in single or multiple layers of sufficient stiffness for uniform loading.
- C. Install pre-cut segments in accordance with manufacturer recommendations to match shape of equipment base.

3.6 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.7 CONCRETE EQUIPMENT BASES

- A. Housekeeping Pads: Construct concrete housekeeping pads a minimum of 4-inches thick and 6-inches larger in both directions than supported unit.

- B. Exterior Equipment Pads: Construct exterior equipment pads a minimum of 8-inches thick and 6-inches larger in both directions than supported unit unless noted otherwise.
- C. Use 3000-psi, 28-day compressive-strength concrete unless otherwise noted. Comply with Division 03 Section "Cast-in-Place Concrete" and ACI standards for subbase requirements, concrete materials, reinforcement, placement, and cover requirements.
 - 1. Reinforce pads with a minimum #4 rebar on 12-inch centers each way or equivalent welded wire fabric. Support reinforcement and tie together to prevent displacement during construction.
 - 2. For interior pads, provide #4 dowels at 24-inch centers each way (minimum of 4) to anchor to structural slab below. Embed dowels into slab a minimum of 3-inches.
 - 3. Provide rubbed finish for all surfaces.
 - 4. Provide 3/4-inch chamfer at all exposed edges.
 - 5. Provide Engineer approved repairs if pad surface is rough or shows signs of honeycomb.
 - 6. Provide crown for exterior pads with a slope of 1/8-inch per foot.
 - 7. Do not set heavy equipment on pad for at least 7 days after pour unless approved by Engineer.
- D. Anchor equipment to concrete base.
 - 1. Locate anchors to be a minimum of 10 bolt diameters from edge of the base.
 - 2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 4. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.8 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Coordinate all required openings and provide sleeves and inserts prior to construction of wall and floor systems. Where openings are missed or incorrectly located, provide core-drilling and patching at no additional expense to owner.
- C. Install sleeves without compromising structural integrity of wall or floor.
- D. Sleeves for Conduits or Cable 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.
 - 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. Unless sleeve seal systems are used, size pipe sleeves to provide a minimum 1/4-inch annular clear space between sleeve and raceway. Where conduit motion due to expansion and contraction will occur, provide sleeves a minimum of two conduit sizes larger than the nominal conduit diameter.

3. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls.
 - a. For conduit penetrations, cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - b. For cable penetrations, extend sleeve a minimum of 2-inches beyond surface of wall and provide plastic insulated bushing.
 4. Install sleeves for floor penetrations. Extend sleeves installed in floors a minimum of 6-inches above finished floor level unless noted otherwise. Install sleeves during erection of floors.
 5. Fasten sleeves securely in floors, walls, so that they will not become displaced when concrete is poured or when other construction occurs around them. Take precautions to prevent concrete, plaster or other materials being forced into the space between pipe and sleeve during construction.
- E. Sleeves for Cables 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 or acoustical sealant for gypsum board assemblies.
- F. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units and counter flashing applied in coordination with roofing work. Coordinate all work with roofing system to maintain roof warranty.
- G. Exterior-Wall and Floor Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal system. Size sleeves to allow for manufacturer recommended annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Where sleeves are installed in core drilled openings, grout sleeve into the opening.
- H. Where sleeves are installed exposed in finished spaces, provide metal escutcheon plates of size to match the sleeve.
- I. Sleeve-Seal-System:
1. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
 2. 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.

3.9 ELECTRICAL SYSTEM FIRESTOPPING INSTALLATION

- A. Install firestopping at all penetrations of fire-rated assemblies. Comply with requirements in Division 07 and as outlined below.
- B. Coordinate location and proper selection of firestop devices with fire rated assembly. Ensure cast-in place devices are installed before placement of concrete.

- C. Install firestop materials in accordance with UL Fire Resistance Directory and manufacturer's instructions.
- D. Affix permanent label to each side of penetration immediately adjacent to firestopping to communicate to future installers and code authorities the following:
 - 1. Fire-stop product/system used
 - 2. Installation Company
 - 3. Penetration Hour Rating
 - 4. Installation Date
- E. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspection by applicable code authorities.

3.10 PAINTING

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION – 260500

SECTION 260503 - SHOP DRAWINGS, SUBMITTALS, LITERATURE, MANUALS, PARTS LISTS, AND SPECIAL TOOLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260500 – Common Work Results for Electrical Systems as they apply to their work.
- D. Each Electrical Contractor's attention is directed to Section 260010 – General Requirements for Electrical Systems as they apply to their work.

1.2 SUMMARY

- A. Each Contractor shall submit to the Architect and/or Engineer, within thirty days after the date of the Contract, one (1) set of shop drawings and/or manufacturer's descriptive literature on all equipment required for the fulfillment of his contract. Each shop drawing and/or manufacturer's descriptive literature shall have proper notation indicated on it and shall be clearly referenced so the specifications, schedules, light fixture numbers, panel names and numbers, etc., so that the Architect and/or Engineer may readily determine the particular item the Contractor proposes to furnish. All data and information scheduled, noted or specified by hand shall be noted in color red on the submittals. The Contractor shall make any corrections or changes required and shall resubmit for final review as requested. Review of such drawings, descriptive literature and/or schedules shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless they have, in writing, directed the reviewer's attention to such deviations at the time of submission of drawings, literature and manuals; nor shall it relieve them from responsibility for errors or omissions of any nature in shop drawings, literature and manuals. The term "as specified" will not be accepted.
- B. If the Contractor fails to comply with the requirements set forth above, the Architect and/or Engineer shall have the option of selecting any or all items listed in the specifications or on the drawings, and the Contractor will be required to provide all materials in accordance with this list.
- C. Review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the contract documents. In all cases, the installing Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.
- D. The Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for the adaptability of the equipment or materials to the project, compliance with applicable codes, rules, regulations, information that pertains to fabrication and installation, dimensions and quantities, electrical characteristics, and coordination of the work with all other trades involved in this project.

- E. No cutting, fitting, rough-in, connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractors concerned. It shall be each Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. Each Contractor shall coordinate with all the other Contractors having any connections, roughing-in, etc., to the equipment, to make certain proper fit, space coordination, voltage and phase relationships are accomplished.
- F. Shop Drawings: Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
- G. Product Data: Submittal shall include performance and characteristic curves.

1.3 SUBMITTALS AND SHOP DRAWING

- A. In accord with the provisions specified hereinbefore, shop drawings, descriptive literature and schedules shall be submitted on each of the following indicated items as well as any equipment or systems deemed necessary by the Engineer:

Power Equipment

- a. Panelboards.
- b. Circuit breakers and fusible switches, per each type.
- c. Disconnect switches.
- d. Fuses, per each type required.
- e. Control components (relays, timers, selector switches, pilots, etc.)

Raceways

- f. Conduits and each type of conduit fittings.
- g. Surface-mounted metal or plastic raceways, with each type of fitting.
- h. Wireways and each type of wireway fitting.
- i. J-hook assembly.

Conductors

- j. Conductors, splicing devices, and connectors, each by type.
- k. Splice or tap blocks.

Devices

- l. Each type of wiring device and their coverplates.
- m. Floor boxes and poke-thrus, each by type, with required accessories.
- n. Data/voice/video wallplates, each by type.
- o. Any special items not listed above.

Lighting

- p. Light fixtures, each by type, marked to indicate all required accessories and lamp selection. Also provide original color selection chart to allow Architect and/or Engineer to indicate color selection.
- q. Lamps, each by type.
- r. Ballast and drivers, each by type.
- s. Photocells, time clocks or other lighting accessories.

- t. Lighting control system schematic, functional & programming data, along with building specific floor plan drawings indicating each device, master controller, input device locations and specific interconnect/wiring requirements for each device.

Fire alarm system.

- u. Note: Each system submittal is to be complete with legible cutsheets for all devices, equipment, special wiring, etc. Include system specific wiring schematics showing each device and its specific interconnect/wiring requirements. For rack mounted equipment, provide a scalable elevation drawing with proposed component locations & specific interconnect wiring requirements for each component/panel. Also provide scale building specific layout drawings that indicate device placement, wiring, etc. Refer to the specific system's specification for additional submittal requirements where required.

Grounding

- v. Electrodes, bonding devices, terminals, etc.
- w. Building service grounding electrode components.

Fire-stopping materials including wrap, caulk, putty, sleeves, etc.

Miscellaneous

- x. Control panel assemblies.
- y. Non-standard junction/pullboxes.
- z. Floor plan and riser drawings that show the location of all fire alarm devices.
- aa. Floor plan and riser drawings that show the location of all low-voltage systems.

Systems

- bb. Note: Each system submittal is to be complete with legible cutsheets for all devices, equipment, special wiring, etc. Also, provide scale building layout drawings that indicate device placement, wiring, etc. Drawings shall be in digital format and shall include complete (not typical) riser diagrams of all systems. Refer to specific system's specification for additional submittal requirements where required.
- cc. Fire alarm system
- dd. Building paging/intercom audio system
- ee. Data network
- ff. Sound reinforcement system(s)
- gg. Wireless intercom system
- hh. Security systems(s)
- ii. Video surveillance system
- jj. All other systems as listed on Systems Responsibility Matrix - See Electrical Legend.

Special wrenches, tools and keys

1.4 FIRE ALARM SHOP DRAWINGS

- A. The Contractor and equipment supplier shall submit to the Architect and/or Engineer, fire alarm system shop drawings complete with catalog cuts, descriptive literature and complete system wiring diagrams for their review prior to the Contractor's submittal to the Commonwealth's Department of Housing, Buildings and Construction or other governing authority for their review.

No work shall be done until drawings are approved by the Kentucky Department of Housing, Buildings and Construction.

- B. Fire alarm drawings shall be created in digital format (CAD or equivalent). Drawings shall include all power supply, battery, and circuit load and voltage drop calculations as required by NFPA. Complete wiring diagrams and proposed device addresses shall be provided.
- C. Shop drawings shall indicate all devices as required to satisfy all local and state mandates, whether indicated on construction drawings or not. Include all components as required for a complete and operational system.
- D. Provide battery back-up calculations indicating batteries have capacity to provide emergency power to the system in compliance with NFPA.
- E. Provide name, location and UL number of UL listed Central Station Monitoring System.

END OF SECTION – 260503

SECTION 260505 – SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, and Division 26 Specifications to be issued with new work.

1.2 SUMMARY

- A. This section covers all demolition, restoration, and salvage required to perform the electrical work indicated on the drawings, specified and/or as required to complete the project. It is the intent of this section of work to remove all existing electrical equipment, materials, etc. which are not required for the completed building and to restore any and all finished surfaces to their original type and conditions. To accomplish these requirements, the Contractor(s) shall, at his own expense, engage the services of others already performing finish work on this project. All work shall be completed to the satisfaction of the Architect/Engineers whose decisions shall be final. This requirement shall apply to all restoration work whether indicated or specified.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and re-installed.
- B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, clean and prepare for reuse, and reinstall where indicated.
- C. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed or salvaged, or removed and reinstalled.
- D. Demolish: Completely remove and legally dispose of off-site.
- E. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.
- F. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner. Include fasteners or brackets needed for reattachment elsewhere.

1.4 SUBMITTALS

- A. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

- B. Pre-demolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective electrical demolition operations. Submit before the Work begins.

1.5 MATERIALS OWNERSHIP

- A. Except for items or materials to be reused, salvaged, reinstalled or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option but in compliance with ordinances and regulations related to the materials being disposed.

1.6 PROJECT CONDITIONS

- A. Building will be occupied during construction. Localized areas to be demolished will be vacated during demolition work. Conduct selective electrical demolition so Owner's operations will not be disrupted.
- B. Corridors immediately adjacent to the demolition areas will be occupied. Conduct demolition so that access to and between occupied areas will be maintained.
- C. On-site storage or sale of removed items or materials is not permitted.

1.7 COORDINATION

- A. Demolition schedule shall not interfere with Owner's on-site operations and operations of adjacent occupied buildings.
- B. Prior to beginning demolition, arrange a conference with the Construction Representative to review electrical demolition scope, procedures, schedule and items to be salvaged for the Owner.
- C. Review requirements of General Demolition Contractor and work performed by other trades that rely on demolition of electrical circuitry or equipment to allow for structural demolition or removal of equipment.
- D. Review areas where existing electrical circuitry and/or equipment is to remain in place and requires protection.

1.8 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

- A. NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION AND RECORDING OF EXISTING CONDITIONS

- A. Contractor is responsible for submitting photos and documenting existing conditions to Owner prior to commencing demolition. Systems and equipment found to be defective after demolition has commenced shall be repaired or replaced by Contractor at no additional cost to Owner.
- B. Notify Construction Representative of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged. Use photographs to document conditions.

3.2 PROTECTION

- A. Comply with governing laws, codes, and regulations governing fire protection and environmental protection during electrical demolition operations.
- B. Existing Utilities: maintain existing utilities and building services and protect from damage during demolition operations.
 - 1. All adjacent areas need to remain in operation and services to other areas outside area of construction need to be maintained during demolition.
 - 2. Disconnect electrical power and communications only to the items of equipment or the panelboard that is identified for removal under the selective electrical demolition scope.
 - 3. Provide temporary services during interruptions to existing utilities or building services as acceptable to Owner and Authorities Having Jurisdiction.
- C. Protect lighting fixtures, exit signs, fire alarm devices, communications devices, etc. that are to remain in place from damage during demolition and construction operations. Exposed fixtures and devices shall have a plastic bag or other suitable covering affixed over the item to protect from dust and paint splatters.
- D. Provide and maintain temporary partitions, dust control barrier, and ventilation per owner's dust control plan.
- E. Temporary enclosures and protection shall be removed by the Contractor upon completion of the electrical demolition work unless otherwise directed by the Construction Representative.

3.3 GENERAL REQUIREMENTS

- A. Demolish and remove existing construction in the area of work to the extent required by new construction unless noted otherwise.

- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.
- C. Where electrical fixtures, equipment or other materials are removed and/or relocated, all abandoned conduit and conductors shall be removed in exposed areas. In concealed areas, materials shall be labeled and abandoned in place or removed as indicated and patch all openings.
- D. The Contractor shall be responsible for the removal and/or relocation of any electrical equipment, fixtures, devices, appurtenances, etc. which may, in the course of construction, interfere with the installation of any new and/or relocated Architectural, Mechanical, Electrical, Structural or Fire Protection Systems whether indicated or not.
- E. Where components of any system in this contractor's scope of work are to be reused, the contractor shall test those components prior to removal and record the state of functionality and condition of the components as tested. These records shall be provided to the owner or engineer upon request. In the absence of these records, all components removed shall be assumed functional at the time of removal. Any device subsequently found to be non-functioning or in unsuitable condition for reuse shall be replaced at the expense of the contractor.
- F. At concealed spaces, such as hollow walls, ducts, and pipe interiors, verify condition and contents of hidden space before starting electrical demolition operations.
- G. All hanger and support material for demolished piping and conduit shall be removed back to the primary structural support member. Grind connection to primary member smooth and touch up with paint to match adjacent surface.
- H. Conduit containing circuits which are to be retained shall remain in place, unless otherwise indicated or required.
- I. Wiring for existing circuits which must be rerouted, or which are partially abandoned, shall be reconnected to service the outlets/loads remaining on the circuit.
- J. All wiring for a circuit which is to be removed or abandoned shall be removed back to the panel which supplied the circuit.
- K. All open conduit knockouts, holes or unused hubs in electrical boxes and enclosures shall be properly plugged with suitable blanking devices that maintain the NEMA rating of the box or enclosure.

3.4 PATCHING AND REPAIRS

- A. Unless otherwise indicated, the Contractor shall be responsible for the patching and repairing of all holes, etc. in the ceiling, wall and floors where electrical equipment is removed.
- B. All damages to buildings, utilities, and services to remain in place shall be promptly repaired at no cost to the Owner.
- C. Where an existing utility or building service is interrupted, the contractor shall work continuously, providing premium time, to repair and restore service.

- D. Neatly cut openings and holes plumb, square and true to dimensions, required.
- E. Demolish concrete and masonry in small sections, cutting at junctures with construction to remain.
- F. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
- G. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- H. All holes or openings in floors, walls or ceilings resulting from electrical demolition shall be properly sealed with material similar to the adjacent surface/finish.
 - 1. Patch holes in concrete floors and ceilings where conduits are removed using non-shrink epoxy grout or concrete material to match existing surfaces and construction.
 - 2. Patch holes in walls and partitions where conduits are removed to match existing construction and finish.
- I. All rough edges of openings created by electrical demolition shall be promptly patched to create a finished surface.
- J. Maintain the fire rating of all floors, walls, partitions and ceilings when patching.

3.5 SALVAGED ITEMS

- A. Items noted to be salvaged shall be cleaned, packed or crated with contents identified on the container. The items shall be stored in a secure area until delivery to Owner. Transport items to storage area designated by Owner. Protect items from damage during transport and storage.

3.6 RE-INSTALLED ITEMS

- A. Items noted to be removed and re-installed shall be carefully removed, cleaned, and repaired to functional condition adequate for intended reuse.
- B. Pack or crate items after cleaning and repairing with contents identified on the container. Store and protect items from damage.
- C. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment.
- D. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.7 EXISTING ITEMS TO REMAIN

- A. Protect construction indicated to remain against damage and soiling during selective electrical demolition.

- B. When permitted by Construction Representative, items may be removed to a suitable, protected storage location during selective electrical demolition and reinstalled in their original locations after selective electrical demolition operations are complete.

3.8 DISPOSAL

- A. Transport demolished materials off Owner's property and dispose of legally in accordance with Federal, State, and local laws and regulations.
- B. Lamps: Legally dispose of lamps in accordance with EPA guidelines.
 - 1. Contractor shall be responsible for the careful removal of all lamps and fluorescent tubes without breakage from existing lighting fixtures.
 - 2. Lamps removed from fluorescent, metal halide, mercury vapor, and sodium fixtures that do not have green end caps shall be placed by the Contractor in cardboard boxes. The Contractor shall label each box with type and quantity of lamps in each box and seal the box. Boxes shall be properly disposed of.
 - 3. Broken, fluorescent, metal halide, mercury vapor, and sodium lamps without green end caps shall be immediately and carefully cleaned up by the Contractor, placed in a 55 gallon steel drum and properly disposed of by the Contractor

3.9 CLEANING

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

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire under 600V.
2. Aluminum building wire under 600V
3. Metal-clad cable, Type MC.
4. Armored cable, Type AC.
5. Fire-alarm wire and cable.
6. Connectors and splices.

B. Related Requirements:

1. Section 260010 "General Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire Company.
3. American Insulated Wire Corp.; a Leviton Company.
4. Belden Inc.
5. Cerro Wire LLC.
6. Encore Wire Corporation.
7. General Cable Technologies Corporation.
8. General Cable Corporation.
9. Senator Wire & Cable Company.
10. Southwire Company.

2.2 BUILDING WIRE

- A. All conductors shall be 98% conductive annealed copper unless otherwise noted in the next paragraph, UL listed and labeled. Comply with ANSI/NEMA WC 70/ICEA S-95-658. Copper shall always be used for feeders and branch circuits below 100amps.
- B. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Copper Conductors: Complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Aluminum Conductors: AA8000 Aluminum Alloy, complying with ASTM B 800 and ASTM B 801. For use of feeders greater than 100 amps.
- F. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.
 - 2. Types THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 - 3. Type XHHW-2: Comply with UL 44.
- G. Shield (*where specified on drawings*):
 - 1. Type TC-ER: Cable designed for use with ASDs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

2.3 FIRE-ALARM WIRE AND CABLE

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. All fire alarm cabling shall be installed in conduit.
 - 1. Where installed within conduit twisted shielded cabling shall still be used.
- C. Fire alarm cabling installed underground to a PIV or similar device wet listed conductor insulation shall be used. This can consist of XHHW stranded conductor.
- D. Signaling Line Circuits: Twisted, shielded pair, No. 16 AWG.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

- E. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. 3M; Electrical Products Division.
 - 2. AFC Cable Systems, Inc.
 - 3. Burndy
 - 4. Gardner Bender.
 - 5. Hubbell Power Systems, Inc.
 - 6. Ideal Industries, Inc.
 - 7. ILSCO.
 - 8. NSi Industries LLC.
 - 9. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 - 10. Reliable
 - 11. T&B
 - 12. Tyco Electronics Corp.
- G. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- H. Splicing devices for use on #10 AWG and smaller conductors shall be pressure type such as T&B "Sta-Kon".
- I. Wire nuts shall be spring pressure type, insulation 600V, 105°C insulation, up to #8 AWG. Greater than #6 AWG shall be a compression type connection, 600V insulation, cold shrink tubing, taped to restore full insulation value of the wire being spliced.
- J. Pressure crimp-applied ring type (or fork with upturned ends) terminations shall be employed on motor and equipment terminals where such terminals are provided on motor and equipment leads or on all stranded wire terminations using #10 AWG or smaller conductors.
- K. Splices, where necessary, shall be made with hydraulically-set "Hy-press" or equivalent crimped connectors. All splices shall be insulated to the full value of the wiring insulation using a cold-shrink kit or the equivalent in built-up materials.
- L. Large connectors (lugs) at terminals shall be mechanical type, hex-head socket or crimp-on style, installed per the manufacturer's recommendations.
- M. Underground connections made between bare ground wires or to ground rods shall be exothermically welded, "Cadweld" or equivalent.
- N. No aluminum splicing devices or connectors shall be used.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:

1. Copper conductors; solid OR stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 2. 2-hour rated cabling is required for all circuits and feeders that serve functions required for life safety functions per NEC 710-8. It is the intention of this project to run all feeders underslab or within a 2-hour rated room in lieu of special cabling.
 - a. 2-hour rating can be accomplished by staying outside of the building footprint (under slab), Or being protected by 2" of concrete cover on vertical runs.
 - b. MI cable can be utilized
 - c. Full sprinkler protection above feeder in compliance with 710-8 is also acceptable.
- B. All conductors shall be 98% conductive annealed Copper unless otherwise noted, UL listed and labeled. Comply with ANSI/NEMA WC 70/ICEA S-95-658.
- C. Conductor sizes indicated on drawings are based upon 75 degree C rating.
- D. Minimum branch circuit or feeder size shall be not less than #12 AWG copper wire or of the sizes shown on the drawings.
- E. All wire on the project shall be new, in good condition, and shall be delivered in standard coils or reels.
- F. The color of the wire shall be selected to conform to Section 210-5 of the latest edition of the National Electrical Code. Power conductors of all sizes shall follow the color coding scheme listed under PART 3, IDENTIFICATION below.
- G. Conductors for main ground from neutral bus, equipment grounding bus, building steel, grounding grid and main cold water pipe connection shall be bare copper.
- H. All conductors shall be identified by color code and by means of labels placed on conductors in all junction boxes and at each terminal point with Brady, Ideal, T & B or approved equivalent labels indicating source, circuit number or terminal number.
- I. All feeders and branch circuits shall be installed and sized for a maximum 2% voltage drop. As calculated using 80% of the supply breaker rating as the load. Adjust conductors and conduit size accordingly for actual field installed conditions.
 1. EC shall be responsible for voltage drop calculations for the project, this includes feeders and branch circuits.
- J. Motor Connections shall use connection lugs with motor stub splice insulators.
- K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- L. All conduits installed without conductors shall have a 200 lb. test nylon string installed for future use, tied off securely at each end.
- M. No more than 40% conduit fill permitted for any conduit system, including video, intercom, data, voice, power or other signal circuits unless specifically indicated otherwise on the plans.
- N. No more than seven conductors (six current-carrying and one ground) shall be installed in a conduit except for switch legs and travelers in multi-point switching arrangements. Multi-wire branch circuits with a shared neutral are not allowed.
- O. If multiple circuits are pulled in a single homerun, a dedicated neutral shall be provided for each phase conductor. In these cases, a maximum of seven conductors (six current carrying and one ground) are permitted in a single conduit. Conductors shall be derated per NEC.
- P. For 120VAC, 20AMP branch circuits:
 1. #12 AWG when run is 50 feet or less;
 2. #10 AWG when run is between 50 feet and 100 feet;

3. #8 AWG when run is more than 100 feet.

Q. ASD Output Circuits Cable: Extra-flexible stranded for all sizes.

R. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

S. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.2 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. If multiple circuit MC cable is utilized dedicated neutrals are still required, and the neutrals within the MC cable shall be identifiable to the circuit they are serving.

C. MC Cable Supports shall be per NEC and all runs shall be parallel or perpendicular to building lines with right angle turns. Cables shall be bundled where run in groups using listed supports. Do not route through structure or on work of other trades.

1. Provide independent supports directly from structure such as independent ceiling grid wires or uni-strut.

D. MC cable is not acceptable for the following applications:

1. Entire length of homeruns back to exposed structure area of electrical room where conduit is required.
2. Branch circuits serving HVAC, elevator/escalator, medical and kitchen equipment loads.

3. Within mechanical, electrical or telecommunication equipment rooms.
 4. Exposed Branch Circuits within areas that do not have a ceiling (i.e. open to structure).
 5. Wet locations.
 6. Any circuit that requires conductors larger than #10AWG.
- E. MC cable may be used for branch circuits where concealed in walls, above ceilings, etc. MC Cable connections are permissible for connection between fixture to fixture.
- F. 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. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
 4. Lock nuts shall be used for all MC cable connections, quick connectors, and internal box clamps are NOT acceptable without permission from the engineer.
- G. Circuits:
1. Single circuit and multicircuit with color-coded conductors.
 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
1. Where Open cabling is permitted; Install plenum cable in environmental airspaces, including plenum ceilings.
 - a. This applies to BMS, Security and structured cabling.
 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
 - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 3. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Color coding distribution voltage conductors, 600 volts or less
- B. Conductors, in all sizes of cable, shall have continuous solid insulation color(s) from the manufacturer. Taped ends shall not be acceptable.
- C. All branch circuits shall have adhesive label identifying circuit number on line voltage wire and neutral
 - 1. Conductors shall be color coded as follows:
 - a. 120/208 Volt Conductors
 - 1) Phase A: Black
 - 2) Phase B: Red
 - 3) Phase C: Blue
 - 4) Neutral: White
 - 5) Ground: Green
 - b. 277/480 Volt Conductors
 - 1) Phase A: Brown
 - 2) Phase B: Orange

- 3) Phase C: Yellow
 - 4) Neutral: Gray
 - 5) Ground: Green
- 2. DC Wiring: Positive: Light Blue
Negative: Dark Blue
 - a. Note: Further identify isolated power conductors with ½" wide purple tape at all terminations and junctions.

3.7 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."

3.8 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."

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

- a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. 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 – 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER 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. Backboards.
 - 2. Category 5e balanced twisted pair cable.
 - 3. Category 6 balanced twisted pair cable.
 - 4. Category 6a balanced twisted pair cable.
 - 5. Balanced twisted pair cabling hardware.
 - 6. RS-485 cabling.
 - 7. Low-voltage control cabling.
 - 8. Control-circuit conductors.
 - 9. Identification products.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- D. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency, RCDD, layout technician, installation supervisor, and field inspector.

- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
- E. Must contain less than 300 ppm lead content.

2.2 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 120 inches. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."
- B. Painting: Paint plywood on all sides and edges with flat alkyd paint. Comply with requirements in Section 099123 "Interior Painting."

2.3 CATEGORY 5e BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.

- B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.
- C. Conductors: 100-ohm, 24 AWG solid copper.
- D. Shielding/Screening: Shielded twisted pairs (FTP).
- E. Cable Rating: Riser.
- F. Jacket: Per OWNER Standards, and schedule, thermoplastic.

2.4 CATEGORY 6 BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Shielded twisted pairs (FTP).
- E. Cable Rating: Riser.
- F. Jacket: Per OWNER Standards and schedule, thermoplastic.

2.5 CATEGORY 6a BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.
- B. Standard: Comply with TIA-568-C.2 for Category 6a cables.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Shielded twisted pairs (FTP).
- E. Cable Rating: Riser.
- F. Jacket: Per OWNER standards, thermoplastic.

2.6 BALANCED TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.
- B. General Requirements for Balanced Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 5e Category 6 Category 6a.

2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain balanced twisted pair cable hardware from single source from single manufacturer.
- D. Connecting Blocks: 66-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
 3. Number of Jacks per Field: One for each four-pair cable indicated.

2.7 TWIN-AXIAL DATA HIGHWAY CABLE

- A. Standard Cable: NFPA 70, Type CM.
1. Paired, pairs, No. 20 AWG, stranded (7x28) tinned-copper conductors.
 2. Polypropylene insulation.
 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. PVC jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
 6. Flame Resistance: Comply with UL 1685.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, pairs, No. 20 AWG, stranded (7x28) tinned-copper conductors.
 2. Plastic insulation.
 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. Plastic jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
 6. Flame Resistance: Comply with NFPA 262.

2.8 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CMG.
 - 1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1685.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Fluorinated ethylene propylene jacket.
 - 5. Flame Resistance: NFPA 262.

2.9 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 - 1. Multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1685.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - 1. Multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with NFPA 262.

2.10 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- B. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- C.
- D. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.
 - 1. Smoke control signaling and control circuits.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
 - 2. Outlet boxes for cables shall be no smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 - 3. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering the room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.
3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inches of cable in a coil not less than 12 inches in diameter.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 1. Class 1 remote-control and signal circuits; No 14 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.9 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. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- F. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- G. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

END OF SECTION - 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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 grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Submit Manufacturers technical data for each product, including related accessories. Furnish a material list with technical data documenting the location and primary function, quality and performance of each material component or system to be used in the work, or other such primary characteristics as required by the drawings or specifications.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 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:
 - b.
 - 1) Ground rods.
 - 2) Ground rings.
 - 3) Grounding arrangements and connections for separately derived systems.
 - c. Instructions for periodic testing and inspection of grounding features at test wells ground rings & 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.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Listing and labeling: Provide products specified in this Section that are listed and labeled.
- D. Comply with NECA's "Standard of Installation."

2.2 MANUFACTURERS

- 1. Erico
- 2. ILSCO
- 3. Cadweld
- 4. Burndy
- 5. Therm-O-Weld

6. T&B
7. O.A. Co.
8. Lyncole XIT Grounding
9. Superior Grounding Systems
10. LEC Inc

2.3 CONDUCTORS

- A. All Grounding conductors shall be copper. If Aluminum conductors are specified for feeders, the Grounding, Bonding & Grounding Electrode conductors are required to be copper.
- B. Comply with Specification Section 260519, LOW-VOLTAGE ELECTRICAL POWER, CONDUCTORS, CABLES, SPLICING DEVICES AND CONNECTORS.

2.4 Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

- A. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches by 24" long (Length on contract document details would supersede this section) 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.
 1. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600V. Lexan or PVC, impulse tested at 5000 V.

2.5 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. Mechanical type: cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar per EIA/TIA standards.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated 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 hex head bolt OR socket set screw.
- J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- K. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- L. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- M. Straps: Solid copper, cast-bronze clamp OR copper lugs. Rated for 600 A.
- N. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.
- O. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- P. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with stainless-steel 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.
- Q. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long, molecularly bonded copper to high-strength steel core, copper thickness per UL/ANSI..
 - 1. Model Number: K2-(length)CS.
 - 2. Provide grounding system with the following components: protective box, backfill material. Box to be concrete with cast iron, tamper-resistant lid, backfill to be "Bentonite" clay.
- R. Installation of Pipe Ground System:
 - 1. Pipe ground systems shall be installed exactly as required by the system manufacturer. The Contractor shall be diligent to observe the excavation, sealing tape removal, slurry backfill and all other critical requirements.
 - 2. Note: NEVER USE SAND OR ORDINARY EARTH AS A BACKFILL MATERIAL
 - 3. Pipe grounding system shall be warranted unconditionally by the Contractor for a period of one year from the date of substantial completion.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 6 AWG and smaller, and stranded conductors for No. 4 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, #3/0 AWG minimum or as indicated on drawings, whichever is larger.

1. Bury at least 24 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. 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.
- E. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.

3.2 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.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits. Utilizing a sheath or Conduit for the grounding means is NOT acceptable.
- 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. Elevator Feeder Circuits: Install parity sized insulated equipment grounding conductor in feeders supplying Elevator 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.

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.

- E. 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.
- F. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 6 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.

3.4 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. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Grounding connections shall **never** be made to fire protection, natural gas, flammable gas or liquid fuel piping, except where specifically indicated on the plans.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column OR indicated item, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 3/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches from building's foundation.
- I. 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.
- J. 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.

- K. 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.

3.5 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.

END OF SECTION - 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. Steel slotted support systems.
 - 2. Aluminum slotted support systems.
 - 3. Nonmetallic slotted support systems.
 - 4. Conduit and cable support devices.
 - 5. Support for conductors in vertical conduit.
 - 6. Structural steel for fabricated supports and restraints.
 - 7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 8. Fabricated metal equipment support assemblies.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit
- C. LFMC: Liquid-tight flexible metal conduit
- D. GRS: Galvanized rigid steel conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this project, with a minimum structural safety factor of five times the applied force.
- E. Related Requirements:

1.5 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 the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings; For fabrication and installation details for electrical hangers and support systems.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
 - 1. Include design calculations and details of hangers.
 - 2. Include design calculations for seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which hangers and supports will be attached.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Items penetrating finished ceiling, including the following:
 - 5. Lighting fixtures.
 - 6. Air outlets and inlets.
 - 7. Speakers.
 - 8. Sprinklers.
 - 9. Access panels.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. Thomas & Betts Corporation.
 - e. Unistrut; Tyco International, Ltd.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.

2.3 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 3. Channel Width: Selected for applicable load criteria
 - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.
- F. Device Box Mounting Brackets: Factory-fabricated sheet steel brackets for support of device boxes adjacent to or between studs.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
- G. Through-Stud Cable and Raceway Support Clips: Factory-fabricated spring steel clip for cables or raceways where run horizontally through metal studs.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
- H. Roof-mounted Raceway Support Blocking: Factory-fabricated support blocking for use under roof-mounted raceways. Wedge-shaped blocking constructed of 100% recycled UV-resistant Rubber with integral galvanized steel strut to accept raceway support clips.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Cooper B-Line C-Port series components or a comparable product by one of the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
- I. Tee Bar Grid Box Hanger: Factory-fabricated metal electrical box hanger for supporting boxes at locations between ceiling system t-grid components. Height adjustable for various electrical box depths. Attached to ceiling tee bar with screws or integral clamp for stability. Includes tab for independent support wire attachment.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.

2.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

2.5 VIBRATION ISOLATION PADS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Korfund Maxi-Flex Pads or a comparable product by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1, NECA 101, 102, 105, 111 and NFPA 70
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps OR single-bolt conduit clamps using spring friction action for retention in support channel.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NFPA 70, NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69 Spring-tension clamps.
 - 7. To Light Steel: Sheet metal screws.
 - 8. For Surface-Mounted Items on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to structure by means that meet seismic-restraint strength and anchorage requirements. Attachment to gypsum wall board is not acceptable as sole support means; slotted-channel rack solidly attached to structure or light-gauge metal framing at both ends is required.
 - 9. For Recessed-Mounted Items in Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices to intermediate light-gauge metal framing members on each side of device or provide slotted-channel racks within hollow wall attached to structure by means that meet seismic-restraint strength and anchorage requirements. Attachment to gypsum wall board is not acceptable as sole support means.
- D. Do not support any items (equipment, piping, conduit, etc.) exceeding 2 inches in diameter from the bottom of slabs. Where intermediate supports are required between structural members, use slotted steel channels support systems attached to beams or joists in order to avoid attachment to slabs.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars. Verify reinforcing locations with Structural Engineer. X-Ray existing concrete structures as required.

3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.]

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 9 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION – 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-A and Type EMT-SS raceways and elbows.
2. Type EMT-S raceways and elbows.
3. Type ENT raceways and fittings.
4. Type EPEC raceways and fittings.
5. Type ERMC-A and Type ERMC-SS raceways, elbows, couplings, and nipples.
6. Type ERMC-S raceways, elbows, couplings, and nipples.
7. Type FMC-S and Type FMC-A raceways.
8. Type FMT raceways.
9. Type IMC raceways.
10. Type LFMC raceways.
11. Type LFNC raceways.
12. Type PVC raceways and fittings.
13. Type RTRC-AG raceways and fittings.
14. Type RTRC-BG raceways and fittings.
15. Fittings for conduit, tubing, and cable.
16. Threaded metal joint compound.
17. Solvent cements.
18. Surface metal raceways and fittings.
19. Surface nonmetallic raceways.
20. Strut-type channel raceways and fittings.
21. Wireways and auxiliary gutters.
22. Metallic outlet boxes, device boxes, rings, and covers.
23. Termination boxes.
24. Cabinets, cutout boxes, junction boxes, pull boxes, and miscellaneous enclosures.
25. Cover plates for device boxes.
26. Hoods for outlet boxes.

B. Related Requirements:

1. Section 260010 "General Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Wireways and auxiliary gutters.
2. Surface metal raceways.

3. Surface nonmetallic raceways.
4. Floor boxes.
5. Cabinets, cutout boxes, and miscellaneous enclosures.

- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details. Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

1.3 INFORMATIONAL SUBMITTALS

1. Submit Shop Drawings of the complete metal surface raceway system.
2. Shop Drawings shall include sizes and lengths of raceways, inside corners, outside corners, end caps, raceway cover spacing, grounding, branch circuiting and wiring including locations of service entrances, receptacle types and manufacturers, receptacle spacing, and receptacle labeling with proper voltage, phase, circuit and panelboard designations as indicated on the Drawings.

PART 2 - PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Anamet Electrical, Inc.
 4. Electri-Flex Company.
 5. O-Z/Gedney; a brand of EGS Electrical Group.
 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
 7. Republic Conduit.
 8. Robroy Industries.
 9. Southwire Company.
 10. Thomas & Betts Corporation.
 11. Western Tube and Conduit Corporation.
 12. Wheatland Tube Company; a division of John Maneely Company.

2.1 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. 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. Must contain less than 300 ppm lead content.
 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

5. MC cable is only permitted after the homerun is installed in EMT. It is intended that MC cable would be used for in-wall rough-ins and connections to light fixtures.
 - a. Homeruns must be in EMT to the room the circuit serves.
 - b. MC cable is not acceptable on generator energized circuits.
 - c. MC shall not in exposed areas such as electrical rooms, Gymnasium etc.
- C. Circuits:
 1. Single circuit
 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- 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. Armor: Steel or Aluminum, interlocked.

2.2 TYPE EMT-S RACEWAYS AND ELBOWS

- A. Steel Electrical Metal Tubing (EMT-S) and Elbows:
 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 797 and UL Category Control Number FJMX.
 - 2) Material: Steel.
 - 3) Exterior Coating: Zinc OR Alternate corrosion-resistant coating.
 - 4) Interior Coating: Zinc.
 - 5) Minimum Trade Size: 3/4 inch.

2.3 TYPE ERM-C-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

- A. Galvanized-Steel Electrical Rigid Metal Conduit (ERM-C-S-G), Elbows, Couplings, and Nipples:
 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 6 and UL Category Control Number DYIX.

- 2) Exterior Coating: Zinc.
 - 3) Interior Coating: Zinc.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch.
- B. PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:
 - 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 6 and UL Category Control Number DYIX.
 - 2) Exterior Coating: PVC complying with NEMA RN 1 and marked ETL Verified PVC-001.
 - 3) Interior Coating: Zinc.
 - 4) Fittings for PVC-Coated Conduit:
 - a) Minimum coating thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
 - b) Conduit bodies must be Form 8 with an effective seal and a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours must be available. Conduit bodies must be supplied with plastic-encapsulated stainless steel cover screws.
 - c) Form 2 inch long or one pipe diameter long, whichever is less, PVC sleeve at openings of female fittings, except unions. Inside sleeve diameter must be matched to outside diameter of metal conduit.
 - d) PVC coating on the outside of conduit couplings must be protected from tool damage during installation.
 - e) Female threads on fittings and couplings must be protected by urethane coating.
 - f) Fittings must be from same manufacturer as conduit.
 - g) Beam clamps and U bolts must be formed and sized to fit outside diameter of coated conduit. Plastic-encapsulated nuts must cover the exposed portions of threads.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch.
 - 2) Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - 3) Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.4 TYPE FMC-S AND TYPE FMC-A RACEWAYS

- A. Steel Flexible Metal Conduit (FMC-S):
 - 1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standard: UL 1 and UL Category Control Number DXUZ.
 - 2) Material: Steel.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch.

2.5 TYPE LFMC RACEWAYS

A. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

- 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standard: UL 360 and UL Category Control Number DXHR.
 - 2) Material: spiral Wound, interlocked, double-wrapped hot-dipped steel core. Jacket shall be flexible, PVC that is fully weatherproof, flame-retardant, Heat, oil and sunlight resistant.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch.
 - 2) Maximum length of any LFMC conduit is 3'
 - 3) Provide strain relief fittings equivalent to "Kellums" as required where subject to vibration.
 - 4) For indoor furniture connections and other connections in finished areas provide smooth jacket
 - 5) Flexible connections to motors or pumps in dusty areas shall have dust-tight connections.
 - 6) Full sized parity ground is required within LFMC, strapping to the exterior is prohibited.

2.6 TYPE PVC RACEWAYS AND FITTINGS

A. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

- 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

- 1) Reference Standards: UL 651 and UL Category Control Number DZYR.
- 2) Dimensional Specifications: Schedule 40.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.
- 2) Markings: For use with maximum 90 deg C wire. For directional boring applications.

B. Fittings for Type EMT Raceways:

a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

- 1) Reference Standards: UL 514B and UL Category Control Number FKAV.
- 2) Material: Steel.
 - a) Indentation or Die-cast fittings shall not be permitted in any raceway system.
- 3) Coupling Method: Compression coupling shall be used for all conduits 2-1/2" and below, 3" and above shall be setscrew with two setscrews on each side. Conduit stops shall be provided within coupling
 - a) Raintight compression coupling with distinctive color gland, nut Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
- 4) All fittings shall be locknut style, snap in or quick style connections are not permissible.
- 5) Provide screw type grounding terminal for metal ground bushings of insulated type.
- 6) All fittings such as chase nipples, reducing fittings, split couplings shall be steel and specifically designed for the application it is being used for.
- 7) Compression type fittings shall be utilized for EMT conduit installed in damp or dusty locations, or where otherwise indicated.
- 8) All conduit fittings shall be securely tightened. All threaded fittings shall engage seven full threads. Fasteners shall be properly torqued to manufacturer's recommendations.

c. Options:

- 1) Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
- 2) Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type FMC Raceways:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number ILNR.
- D. Fittings for Type LFMC and Type LFNC Raceways:
 - 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number DXAS.
 - 2) All fittings shall be locknut style, snap in or quick style connections are not permissible.
 - 3) All LFMC fittings shall comply with FS W-F 406 Type 1, class 3 style G. Provide Cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings with insulated throat.

2.7 SOLVENT CEMENTS

- 1. For field applications inside the building weatherproofing system: Solvent cements and adhesive primers, documentation including printed statement of VOC content.
- 2. Laboratory Test Reports: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

- A. Metallic Outlet Boxes:
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 2. Steel City
 - 3. Erickson Electrical Equipment Company.
 - 4. FSR Inc.
 - 5. Hoffman; a Pentair company.
 - 6. Hubbell Incorporated; Killark Division.
 - 7. O-Z/Gedney; a brand of EGS Electrical Group.
 - 8. RACO; a Hubbell Company.
 - 9. Thomas & Betts Corporation.
- 10. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables,

with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.

11. Provide boxes with raised threaded screw terminals for ground wire. All devices shall be connected via ground screw, other methods are not permissible.
12. Provide outlet box accessories required for the specific application. This includes box supports, mounting ears, wallboard hangers, extension/mud rings, additional studs, and cable clamps.
13. Internal MC Cable clamps are not acceptable, all connections shall be lock-nut.
14. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - c. Options:
 - 1) Material: Sheet metal.
 - 2) Device box Dimensions: Minimum 2-1/8" deep by 4" square.
 - a) Deeper device boxes will be required for larger devices such as GFI and for wire fill.
 - b) Provide wider boxes where more than two devices will be installed.
 - c) Provide internal Dividers for boxes carrying varying voltages or systems.
 - d) Using Gang-able single gang boxes for multi-gang boxes is prohibited. All boxes must be single components.
 - 3) Cast-Metal Depth: Minimum 2.4 inch.
 - a) Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb
 - b) Outlet boxes designed for luminaires over 50 lb shall be listed and marked for the maximum allowable weight with a 100 percent safety factor.
 - 4) Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.
 - a) 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.

C. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements. 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.
2. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - 2) Conduit bodies, junction boxes and fittings shall be dust tight and threaded for dusty areas, weatherproof for exterior locations and vapor tight for damp areas. Conduit fittings shall be as manufactured by Crouse Hinds, Appleton, Killark or approved equivalent. All surface mounted conduit fittings as with "FS", "FD", "GUB" Types etc., shall be provided with mounting hubs.
 - 3) Conduit bodies "LB's" shall not be used for conduit pull points unless reviewed and approved by the engineer.
 - 4) Conduit bodies "LB's" shall not be used for conduit pull points for low voltage in any circumstance.

D. Metallic Device Boxes:

- 1. Description: Box with provisions for mounting wiring device directly to box.
- 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - c. Options:
 - 1) Material: Sheet steel Sheet aluminum Cast metal.
 - 2) Sheet Metal Depth: minimum 2-1/8".
 - 3) Cast-Metal Depth: minimum 2.4 inch.
 - 4) Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing more than 50 lb and marked with maximum allowable weight.
 - 5) Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

E. Metallic Extension Rings:

- 1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
- 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.

F. Metallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - 2) Refer to drawings for configuration and model #'s

G. Metallic Raised-Floor Boxes and Floor Box Covers:

1. Description: Box mounted in raised-floor with floor box cover and other components to complete floor box enclosure.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - 2) Refer to the architectural drawings for dimensional information on locations. Do not scale floor boxes from the Electrical drawings.

H. Metallic Recessed Access-Floor Boxes and Recessed Floor Box Covers:

1. Description: Floor box with provisions for mounting wiring devices below floor surface and floor box cover with provisions for passage of cords to recessed wiring devices mounted within floor box.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - 2) Refer to electrical drawings for configuration and model #'s
 - 3) Refer to the architectural drawings for dimensional information on locations. Do not scale floor boxes from the Electrical drawings.

I. Metallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.

2. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - 2) Refer to the architectural drawings for dimensional information on locations. Do not scale floor boxes from the Electrical drawings.

2.9 TERMINATION BOXES

- A. Description: Enclosure for termination base consisting of lengths of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors or both.
- B. Termination Boxes and Termination Bases for Installation on Line Side of Service Equipment:
 - 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 1773 and UL Category Control Number XCKT.
 - 2) Listed and labeled for installation on line side of service equipment.
- C. Termination Boxes and Termination Bases for Installation on Load Side of Service Equipment:
 - 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 1773 and UL Category Control Number XCKT.
 - 2) Listed and labeled for installation on load side of service equipment.

2.10 CABINETS, CUTOOT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

- A. Indoor Sheet Metal Cabinets, Pull boxes, and miscellaneous enclosures:
 - 1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
 - 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:

- 1) Reference Standards: UL Category Control Number CYIV.
 - a) Non-Environmental Characteristics: UL 50.
 - b) Environmental Characteristics: UL 50E.
 - c) Must be UL listed for the application it is being used for.
 - d) Provide all necessary parts for a complete enclosure including mounting frames, hardware, cover plates, fillers, and bolts Etc.
 - e) Provide screw-cover type for indoor applications, hinged door with flanges and gaskets for outdoor. Protect sheet metal with rust inhibiting coating and baked enamel finish. Provide plate finishing hardware to prevent corrosion. Protect screws installed into box with spring nuts to prevent damage to conductor insulation.
 - f) Pull boxes, cabinets, and junction box sizes must comply with NEC for straight or angled pull calculations. EC shall provide the calculations and corresponding box size.
 - g) Outdoor applications shall be listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for its intended location and application.

c. Options:

- 1) Degree of Protection: Indoor - Nema 1.
- 2) Degree of protection: Wet Location/Outdoor Nema 3R
- 3) Degree of protection: Corrosive, Hazardous, or Clean room environment: Nema 4X

B. Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL Category Control Number BGUZ.
 - a) Non-Environmental Characteristics: UL 50.
 - b) Environmental Characteristics: UL 50E.
 - c) Must be UL listed for the application it is being used for.
 - d) Provide all necessary parts for a complete enclosure including mounting frames, hardware, cover plates, fillers, and bolts Etc.
 - e) Comply with NEMA FB 1 ferrous alloy, type FD with gasketed covers. If cast boxes are used approval must be given by the engineer.
 - f) Pull boxes, cabinets, and junction box sizes must comply with NEC for straight or angled pull calculations. EC shall provide the calculations and corresponding box size.

- g) Outdoor applications shall be listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for its intended location and application.

a. Options:

- 1) Degree of Protection: Indoor - Nema 1.
- 2) Degree of protection: Wet Location/Outdoor Nema 3R
- 3) Degree of protection: Corrosive, Hazardous, or Clean room environment: Nema 4X

C. Outdoor Polymeric Junction and Pull Boxes (Quazite boxes):

- 1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
- 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL Category Control Number BGUZ.
 - a) Non-Environmental Characteristics: UL 50.
 - b) Environmental Characteristics: UL 50E.
 - c) Refer to drawing detail for installation instructions.
 - d) Where boxes are installed on main feeders' consideration shall be given to water infiltration to the equipment it serves. If conduits are angled towards the building/equipment a plan for water mitigation must be provided. If the condition exists consult with the architect and engineer prior to installation.
 - e) Where water infiltration has is a concern the contractor shall provide storm outlet piping from the junction box to storm retention pond/storm piping outlet or area where it can be daylighted.
 - f) Outdoor boxes shall be installed with a concrete or gravel base per electrical details. Installing in backfill, or soil is not permitted.

c. Options:

- 1) Degree of Protection: Type 3R.

D. Outdoor Sheet Metal Miscellaneous Enclosures:

- 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

- b. For CT cabinets, sectionalizing modules, and all other enclosures required or provided by local utility companies, the equipment shall be installed per the local utility company guidelines. Contractor shall engage and coordinate each installation with the local utility prior to rough in installation.
- c. General Characteristics:
 - 1) Reference Standards:
 - a) UL 1773 and UL Category Control Number XCKT.
 - b) Non-Environmental Characteristics: UL 50.
 - c) Environmental Characteristics: UL 50E.
- d. Options:
 - 1) Degree of Protection: Type 3R.

2.11 COVER PLATES FOR DEVICES BOXES

- A. Color of devices shall be as selected per the device color matrix. Samples (devices, plates or both) may be required to be submitted with other architectural color items by the Contractor. The Contractor shall coordinate any such submission required with other trades, the Prime Contractor or as needed.
- B. Where devices are controlling or supplying emergency power from a standby source, the device color shall be red, as with switch toggles or receptacle fronts. Plate color shall match others on normal power in the building unless otherwise noted.
- C. Where surface finishes next to the devices vary in color or shade throughout the project, the Contractor may be required to provide lighter or darker plates and devices to more closely match wall finishes. These variations are considered to be included in the original contract for construction.
- D. All cover plates shall match in color and size throughout the project size for all devices.
- E. Cover plates for computer, telephone or other system outlets shall be as color and finish to match receptacle plates in each space specified in other sections.
- F. All devices shall be provided with labels with panel and circuit number per electrical identification specification.
- G. All devices within unfinished spaces shall have satin finish stainless steel equal to Leviton 302 series.
- H. Acceptable manufacturers: Leviton, Hubbell, GE
- I. Metallic Cover Plates for Device Boxes:
 - 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:

- 1) All metallic cover plates shall be equal to Leviton 302 series, stainless steel.
- 2) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
- 3) Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
- 4) Wallplate Material: 0.032 inch thick Type 302/304 non-magnetic stainless steel with brushed finish.

2.12 HOODS FOR OUTLET BOXES

A. Extra-Duty, While-in-Use Hoods for Outlet Boxes:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - 2) Marked "Extra-Duty" in accordance with UL 514D.
 - 3) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
 - 4) Mounts to box using fasteners different from wiring device.
- c. Options:
 - 1) Provides gray, weatherproof, "while-in-use" cover.
 - 2) Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- B. Where MC cable is applicable on a project refer to "Low-Voltage Electrical Power conductor and cables" for where MC cable can be applied.
- C. Outdoors:
 1. Exposed Conduit: ERMCMC.

2. Concealed Conduit, Aboveground: ERM, EMT
3. Direct-Buried Conduit: ERM, PVC-40
4. Concrete-Encased Conduit Not in Trench: ERM, PVC-40.
5. Concrete-Encased Conduit in Trench: ERM, PVC-40.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

D. Indoors:

1. Hazardous Classified Locations: ERM
2. Exposed and Subject to Physical Damage: ERM Raceway locations include the following:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
3. Exposed, Not Subject to Physical Damage: ERM, EMT .Raceway locations include the following:
 - a. Electrical and Telecommunication rooms
 - b. Mechanical rooms above 8'
 - c. Air handler or similar equipment rooms.
 - d. Gymnasiums
4. Concealed in Ceilings and Interior Walls and Partitions: ERM, EMT, (MC cable as permitted).
5. Damp or Wet Locations: ERM.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

E. Stub-ups to Above Recessed Ceilings: Provide EMT, ERM for raceways per details on the drawings.

F. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERM: Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:
 - a. Type 3R unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4X.
 - c. Locations Subject to Potential Flooding: Type 6P.

- d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
 - e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
 - f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
2. Indoors:
- a. Type 1 unless otherwise indicated.
 - b. Damp or Dusty Locations: Type 4.
 - c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - e. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
 - f. Locations Exposed to Hosedown: Type 4.
 - g. Locations Exposed to Brief Submersion: Type 6P.
 - h. Locations Exposed to Prolonged Submersion: Type 6P.
 - i. Locations Exposed to Corrosive Agents: Type 4X.
 - j. Locations Exposed to Spraying Oil or Coolants: Type 13.
- C. Exposed Boxes Installed Less Than 6.5 ft. Above Floor:
- 1. Provide cast-metal boxes. Boxes with knockouts or unprotected openings are prohibited.

3.3 INSTALLATION OF RACEWAYS

- A. Installation Standards:
- 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
 - 2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
 - 3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
 - 4. Comply with NECA NEIS 101 for installation of steel raceways.
 - 5. Comply with NECA NEIS 102 for installation of aluminum raceways.
 - 6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
 - 7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - 8. 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.
 - 9. Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG. Install insulated throat metal grounding bushings on service conduits.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft. above finished floor.
3. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inch of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. It is not acceptable to surface mount conduit in finished areas with consent for the Architect or engineer.
6. Install conduits parallel or perpendicular to building lines.
7. Support conduit within 12 inch of enclosures to which attached.
8. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
9. 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 interior of raceways at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - b. Where an underground service raceway enters a building or structure.
 - c. Conduit extending from interior to exterior of building.
 - d. Conduit extending into pressurized duct and equipment.
 - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - f. Where otherwise required by NFPA 70.
10. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
11. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
12. Keep raceways at least 12 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
13. 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. Ream inside of conduit to remove burrs.
14. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
15. Conduit and raceways, as well as supporting inserts in contact with or enclosed in concrete shall comply with the latest edition of all ACI standards and the equipment manufacturer's recommendations for such work.
16. The decision of the Engineer shall be final and binding in any case where a question or inquiry arises regarding the suitability of a particular installation or application of raceways, supports or materials, if other than outlined herein.

17. Minimum size of conduit shall be 3/4" trade size for power and 1-1/4" trade size for phone / data / TV unless otherwise noted on the drawings. All conduit and raceways shall be sized for the number of conductors contained, in accord with the latest edition of the National Electrical Code or any other applicable standards.
18. The installer of raceway systems shall avoid the use of dissimilar metals within raceway installations that would result in galvanic-action corrosion.
19. All raceways shall avoid contact with other trades.
20. P.V.C. or other non-metallic conduit shall be rated for the maximum operating temperature that could be developed by the conductors.
21. Supports and hangers shall be installed in accord with all applicable codes and standards. They shall be corrosion - resistant, galvanized or furnished with an equivalent protective coating. All electrical raceways shall be hung independently from the building structure with UL listed and approved materials. Hangers and supports depending from the support systems of other trades work shall not be permitted, except with specific approval in writing from the Engineer. The use of tie wire for support or fastening of any raceway system is prohibited. Perforated metal tape shall not be used for raceway support.
22. No raceway shall be installed on acoustic tile ceiling tees, or in any location that will impair the functioning, access or code-required clearances for any equipment or system. This includes but is not limited to being run under terminal HVAC units, or other equipment that will need to be removed for replacement.
23. Supports for raceways shall be of materials compatible with the raceway, of malleable iron, spring steel, stamped steel or other approved material. Die-cast fittings are not permitted for supports.
24. The installing contractor shall provide all necessary supports and braces for raceways, in a rigid and safe installation, complying with all applicable codes.
25. Individual conduits routed on building walls or equipment shall be secured by two- hole galvanized malleable iron or stamped steel pipe strap or "minerallac" 2-piece straps. The straps are to be anchored by an approved means such as expansion anchors, toggle bolts, through bolts, etc. Where required by codes or other standards, provide spacers behind mounting clamps to space conduits off walls.
26. Supports may not be fastened to roof decking on drive pins.
27. Individual conduits run on building steel shall be secured by means of clamp supports similar and equal to those manufactured by the C.C. Korn Company, Elcen Co., B-Line or approved equivalent. Provide korn clamps, bulb-tee, flange clamps, beam clamps, "minerallacs", etc.
28. Where feasible, vertical and/or horizontal runs of conduit shall be grouped in common hangers on "trapezes" of channel stock as manufactured by "Unistrut" or equivalent, 1-5/8" minimum depth. Utilize conduit clamps appropriate to the channel.
29. Channel strut systems for supporting electrical equipment or raceways shall be constructed of 16 gauge minimum hot dip galvanized steel with 9/16" diameter holes on 8" centers, with finish coat of paint as manufactured by Unistrut, B-Line, Kindorf, or approved equivalent.
30. The minimum diameter of round all-thread steel rods used for hangers and supports shall be 1/4", 20 threads per inch. All-thread rod shall be furnished with a corrosion-resistant finish.
31. Welding directly on conduit or fittings is not permitted.
32. Provide riser support clamps for vertical conduit runs. Riser support clamps shall be of heavy gauge steel construction. Install riser support clamps at each floor level penetration, or as otherwise required.

33. Provide conduit cable support clamps for vertical conductor runs as required or indicated on plans. Clamps to be insulating wedging plug, with malleable iron support ring. Install within properly sized and anchored junction box.
34. Spring steel clips and fittings such as those manufactured by HITT-Thomas, Caddy-Erico, or approved equivalent, with black oxide finish are permitted in any indoor dry location for concealed work, where acceptable to the local authority having jurisdiction.
35. Raceways shall be securely and rigidly fastened in place at intervals specified here-in-before with wall brackets, conduit clamps, approved conduit hangers, or beam clamps. Fastenings shall be made by wood screws or screw type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat treated or spring steel tension clamps on steel work. Bolts, screws, etc. used in securing the work shall be galvanized and of ample size for the service. Assembly bolts, nuts, washers, etc., shall be zinc or cadmium coated. Raceways shall not be welded to steel structures. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joists shall avoid cutting the main reinforcing bars.
36. The use of perforated iron straps or wire for supporting conduits will not be permitted.
37. Where conduits are installed in groups on a common steel channel type support, each conduit shall be secured by Korns, Unistrut, Kindorf clamps or equal.
38. Rigid conduits, where they enter panelboards, cabinets or pull boxes shall be secured in place by galvanized, double locknuts (one inside and one outside) and non-metallic bushings. All bushings shall have insulating material which has been permanently fastened to the fittings. Bushings for conduit 1-1/2 inches trade size and larger, which are used for power distribution, shall be complete with grounding lug and shall be bonded to the box by means of bare copper wire.
39. Install no more than three 90 degree bends in any conduit run without a pull box.
40. For all empty conduits cap and seal during construction to eliminate debris. For permanent installation all empty conduits shall be terminated in a junction box or provided with a permanent cap or fitting to seal the conduit.
41. Raceways shall not be embedded in slabs, and must be installed 18" below slabs.

C. Requirements for Installation of Specific Raceway Types:

1. Types FMC, LFMC, and LFNC:
 - a. Comply with NEMA RV 3. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
2. Type RTRC:
 - a. Do not install Type RTRC conduit where ambient temperature exceeds 230 deg F.

D. Raceways Under Building Slabs:

1. All conduits shall be run 18" under the building slab unless serving a floor box or specific piece of equipment which requires it to be in the slab. Run raceways larger than 1 inch trade size below concrete slab. All duct banks, and fiber runs shall be concrete encased.
2. Feeders to panels shall not run overhead unless there is a special condition.

- a. Where 2-hour ratings on feeders are required, running under slab is the preferred method.
 3. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
 4. Arrange raceways to ensure that each is surrounded by a minimum of 2 inch of concrete without voids.
 5. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
 6. Change from ENT to ERMCM before rising above floor. This should be done with a rigid ERMCM 90 fitting where turning up into the building slab.
- E. Stub-ups to Above Recessed Ceilings:
- F. Expansion-Joint Fittings:
1. Provide UL listed expansion fittings and coordinating couplings in metal raceways where a structural expansion joint is crossed, wherever deflection is expected, and where environmental temperature changes
 2. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft.. Install in runs of aboveground EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft..
 3. Install type and quantity of fittings that accommodate temperature change listed for 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.
 - e. Formula in first subparagraph below provides about 15 percent safety factor (extra expansion-contraction capability).
 4. 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.
 5. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 6. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- G. Raceways Penetrating Rooms or Walls with Acoustical Requirements:
1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.4 INSTALLATION OF SURFACE RACEWAYS

- A. Install surface raceways only where indicated on Drawings.
- B. Install surface raceway with a minimum 2 inch radius control at bend points.
- C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch (mm) and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.5 INSTALLATION OF BOXES AND ENCLOSURES

- A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
- B. 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 top of box unless otherwise indicated.
- C. 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, whether installed indoors or outdoors.
- D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- E. Locate boxes so that cover or plate will not span different building finishes.
- F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- G. Support of ALL boxes from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- I. Set metal floor boxes level and flush with finished floor surface.
- J. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
- K. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
- L. Do not install outlet boxes in back-back walls. Provide additional studs as required to attain at least 6" of minimum separation. In acoustically rated walls attain at least 16" minimum separation. If a conflict exists where these conditions can not be met the contractor must engage the architect and engineer.

- M. For Fire Walls, fire barriers, smoke barriers, and smoke partitions; steel outlet boxes shall not exceed 16 square inches but only if the total area of such opening does not exceed 100 square inches per 100 square feet of wall area. Provide assemblies that are listed for use in fire/smoke walls and install per tested assembly guidelines.
- N. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - 1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - 2. Provide gaskets for wallplates and covers.

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.

3.8 CLEANING

- A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION – 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Submit Manufacturers technical data for each product, including related accessories. Furnish a material list with technical data documenting the location and primary function, quality and performance of each material component or system to be used in the work, or other such primary characteristics as required by the drawings or specifications.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, 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.
 - 3. Refer to "Electrical Details" drawings for specific installation guidelines. All sleeves for Low voltage systems shall be EZ Path.

- 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 D 1785, 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: Carbon steel.
 - 3. Connecting Bolts and Nuts: 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 C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

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.
 - 1. For field applications inside the building weatherproofing system: Solvent cements and adhesive primers, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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.
 - 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 boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch 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 - 260544

SECTION 260923 - LIGHTING CONTROL 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. Electronic time switches.
 - 2. Outdoor photoelectric switches, low voltage.
 - 3. Daylight-harvesting dimming controls, digital.
 - 4. Indoor occupancy and vacancy sensors.
 - 5. Switchbox-mounted occupancy sensors.
 - 6. Low-voltage, momentary switches.
 - 7. Digital timer light switch.
 - 8. Outdoor motion sensors.
 - 9. Lighting contactors.
 - 10. Emergency shunt relay.
 - 11. Conductors and cables.
- B. Related Requirements:
 - 1. Section 262726 "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: These specifications and the accompanying Drawings define the intent of the lighting control system to be provided. The switches, sensors, control stations and switching group designations shown on the Drawings define how lighting should be grouped for control. Provide the necessary quantity and type of distributed control products necessary to achieve the design intent. In addition to the system as specified herein and shown on the Drawings, provide all planning, design, calculations, equipment, devices, cabling, system programming and any other component or service required for a complete, fully operational and code compliant system.

1.4 ACTION SUBMITTALS

- A. Submit product data and shop drawings in accordance with Division 01 and Division 26 Section "Electrical Shop Drawings and Submittals" for products specified under PART 2 - PRODUCTS.
- B. Product Data: For each type of product.

C. 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.

1.5 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.

1.6 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 USB media. Provide names, versions, and website addresses for locations of installed software.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.7 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including but not limited to luminaires, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.8 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Industries, Inc.
 - 2. Intermatic, Inc.
 - 3. Leviton Manufacturing Co., Inc.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
 - 1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
 - 2. Contact Configuration: SPST.
 - 3. Contact Rating: 20-A ballast load, 120-/240-V ac.
 - 4. Programs:
 - a. Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 - b. Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
 - c. 4 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
 - d. 4 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule with a skip-a-day weekly schedule.
 - e. 4 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
 - f. 4 channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
 - g. 4 channels; each channel is individually programmable with 40 on-off operations per week, plus four seasonal schedules that modify the basic program and an annual holiday schedule that overrides the weekly operation on holidays.

- h. and an annual holiday schedule that overrides the weekly operation on holidays.
- 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
- 6. Astronomic Time: All channels.
- 7. Automatic daylight savings time changeover.
- 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES, LOW VOLTAGE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Industries, Inc.
 - 2. Intermatic, Inc.
 - 3. Leviton Manufacturing Co., Inc.
- B. Description: Solid state; one set of NO dry contacts rated for 24 V dc at 1 A, to operate connected load, complying with UL 773, and compatible with power pack.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
 - 3. Time Delay: Thirty-second minimum, to prevent false operation.
 - 4. Mounting: 1/2-inch threaded male conduit.
 - 5. Failure Mode: Luminaire stays ON.
 - 6. Power Pack:
 - a. 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.
 - 1) LED status lights to indicate load status.
 - 2) Plenum rated.
 - b. Digital controller capable of accepting four RJ45 inputs with two outputs rated for 20-A LED load at 120- and 277-V ac, for 16-A LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
 - 1) With integral current monitoring.
 - 2) Compatible with digital addressable lighting interface.
 - 3) Plenum rated.

2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS, DIGITAL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Industries, Inc.

2. Hubbell Control Solutions; Hubbell Incorporated, Lighting.
 3. Leviton Manufacturing Co., Inc.
 4. Lithonia Lighting; Acuity Brands Lighting, Inc.
 5. WattStopper; Legrand North America, LLC.
- B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, lights are dimmed.
1. Lighting control set point is based on the following two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
 2. System programming is done with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.
- D. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Sensor Output: zero- to 10-V dc to operate luminaires. Sensor is powered by controller unit.
 3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.
- E. Power Pack: Digital controller capable of accepting four RJ45 inputs with two output(s) rated for 20-A LED load at 120- and 277-V ac, for 16-A LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc Class 2 power source, as defined by NFPA 70.
1. With integral current monitoring.
 2. Compatible with digital addressable lighting interface.
 3. Plenum rated.

2.4 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Refer to the Drawings for a list of acceptable manufacturers.
- B. General Requirements for Sensors:
1. Wall and Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
 2. Dual technology.
 3. Integrated OR Separate power pack.
 4. Hardwired connection to switch and BAS.
 5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

6. Dual output where the occupancy sensor will control the operation of HVAC terminal units.
 7. 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.
 - d. Refer to sequence of operation on the electrical drawings for additional information.
 8. Sensor Output: Sensor is powered from the power pack.
 9. Power: Integral photovoltaic collector.
 10. 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.
 11. 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.
 12. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 13. Bypass Switch: Override the "on" function in case of sensor failure.
 14. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. 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 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.
 5. The manufacturer is required to provide a layout drawing to ensure the coverage patterns sufficient. Engineered drawings are for reference.

2.5 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Refer to the Drawings for a list of acceptable manufacturers.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 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.

2.6 LOW-VOLTAGE, MOMENTARY SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton, Cooper Industries, Inc.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lutron Electronics Co., Inc.
 - 4. nLight, Acuity Brands Lighting, Inc.
 - 5. WattStopper; Legrand North America, LLC
- B. General Description:
 - 1. Decorator styling compatible with screwless or standard wall plates.
 - 2. Internal green LED which can function as either a locator or pilot light, depending upon application and how the switch is wired.
 - 3. When top of switch is pressed, an internal contact between an on and common terminal is made; when bottom of switch is pressed, an internal contact between an off and common terminal is made.
- C. Wall Plate: Comply with wall plate requirements in Division 26 Section "Wiring Devices".
- D. Finish: Comply with finishes requirements in Division 26 Section "Wiring Devices".

2.7 OUTDOOR MOTION SENSORS

- A. Manufacturers: Refer to the Drawings for a list of acceptable manufacturers.
 - 1. Based on Hubbell wiSCAPE wireless outdoor lighting control system. Approved equals will be accepted.
- B. 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.

2. Dual-technology (PIR and ultrasonic) type, weatherproof. 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.. Comply with UL 773A.
3. Switch Rating:
 - a. Luminaire-Mounted Sensor: 500-VA LED.
 - b. Separately Mounted Sensor: 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.
4. Switch Type: SP.
5. Voltage: Match the circuit voltage type.
6. Detector Coverage:
 - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
 - b. Long Range: 180-degree field of view and 110-foot detection range.
7. 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.
8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
9. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.
12. External fixture modules shall be capable of controlling multiple fixtures upon one triggered event. It is the intention of the project to turn on the entire lighting circuit if one of the fixtures is triggered.
13. The wireless control system shall include all the necessary components such as gateways, antennas, software, and 7-pin fixture modules for a complete functioning system.
14. wiSCAPE or approved equal site lighting controls must integrate with the interior control system for a singular control interface.

2.8 EMERGENCY SHUNT RELAY

- A. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924. The unit provides normal ON/OFF or 0-10V dimming control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
 1. Coil Rating: 120 V.
 2. Push to test button.
 3. Auxiliary contact for remote test or fire alarm system interface.

2.9 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. 22 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. 16 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 INSTALLATION OF SENSORS

- 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.
- D. Switchbox mounted sensors:
 - 1. Set field selectable sensors to automatic "on" automatic "off" for all devices indicated to be Occupancy sensors on the Drawings. Set all other sensors to field selectable manual "on".
 - 2. Comply with installation and connection requirements in Division 26 Section "Wiring Devices."

3.3 INSTALLATION OF CONTACTORS

- A. Comply with NECA 1.

- B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 INSTALLATION OF WIRING

- 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: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's written instructions.
- D. Size conductors in accordance with 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 in accordance with 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. Time-Schedule Adjustments: Times indicated in documents represent initial settings known at time of design documentation. Coordinate final program settings for time-of-day and holiday schedules with Owner prior to Substantial Completion. When requested within 3 months of date of Substantial Completion, provide on-site assistance in adjust schedules to suit Owner. Provide up to one visit to Project during other-than-normal occupancy hours for this purpose.
- B. 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.

3.8 CLEANING

- A. Clean components according to manufacturer's written instructions.
- B. On completion of device box installation but before any wiring devices are installed, inspect interior of boxes and perform the following:
 - 1. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
- C. On completion of wall plate installation, inspect exterior surfaces and perform the following:
 - 1. Remove paint splatters and other spots.
 - 2. Replace cracked or damaged wall plates.
 - 3. Wipe down all wall plates with approve cleaning agent to remove fingerprints and dust.

END OF SECTION 260923

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

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.
- B. Section 016000 Product requirements

1.2 SUMMARY

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
 - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for transformers, 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. Source quality-control reports.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each transformer type from single source from single manufacturer.
- B. Acceptable Manufacturer's: Square D , Eaton, General Electric

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the transformer will remain in place without separation of any parts when subjected to the seismic forces specified"

2.3 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:
 - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 - 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.4 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."
- B. Nameplates: Self-adhesive label for each distribution transformer. Self-adhesive labels are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
 - 1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
 - 2. Ratio tests at rated voltage connections and at all tap connections.
 - 3. Phase relation and polarity tests at rated voltage connections.
 - 4. No load losses, and excitation current and rated voltage at rated voltage connections.
 - 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
 - 6. Applied and induced tensile tests.
 - 7. Regulation and efficiency at rated load and voltage.

8. Insulation-Resistance Tests:
 - a. High-voltage to ground.
 - b. Low-voltage to ground.
 - c. High-voltage to low-voltage.
9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer OR from design drawings signed and sealed by a licensed structural engineer.
 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
 2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" or Section 033053 "Miscellaneous Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 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. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
 1. Visual and Mechanical Inspection.
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, and grounding.
 - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
 - d. Verify the unit is clean.
 - e. Perform specific inspections and mechanical tests recommended by manufacturer.
 - f. Verify that as-left tap connections are as specified.

- g. Verify the presence of surge arresters and that their ratings are as specified.
 - 2. Electrical Tests:
 - a. Measure resistance at each winding, tap, and bolted connection.
 - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
 - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
 - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- F. Remove and replace units that do not pass tests or inspections and retest as specified above.
- G. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- H. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION - 262213

SECTION 262416 - PANELBOARDS

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.
- B. Section 016000 Product requirements
- C. Section 016116 Volatile Organic Compound (VOC) Content restrictions

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 3. Sustainable Design: LEED submittals conforming to requirements listed in section 013329.02 "Sustainable design reporting – LEED v 4.

- a. Provide any of the following documentation: Greenscreen V1.2 benchmark, health product declaration (HPD), Environmental product Declaration (EPD), Pre-consumer and post-consumer recycled content, FSC certified wood, or other documentation as defined in “Sustainable design reporting” – LEED v4.
- b. Failure to provide above documentation will disqualify products where this documentation is required for LEED compliance. Reference “Sustainable Design reporting – LEED v4.
- c. Indoor Environmental quality Credits:
 - 1) Product Data for wet-applied products, indicate VOC content, emissions and volume.
 - 2) Laboratory test reports: For applicable building materials, indicate compliance with requirements for low-emitting materials
 - 3) Where applicable, provide formaldehyde-free documentation.
- d. Sustainable Design:
 - 1) LEED submittals conforming to requirements listed in section 013329.02 “Sustainable design reporting – LEED v4”
 - a) Provide any of the following documentation: NSF61 and NSF 372 Certification, or other documentation as defined in “sustainable design reporting.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 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. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
 - 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than 5 days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
 - 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

- b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:
 - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel Same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors

- shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
7. Split Bus: Vertical buses divided into individual vertical sections.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
 9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
 - J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
 - K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 1. Percentage of Future Space Capacity: 10 percent. (per drawings)
 - L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
 1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
 - M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.

2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 POWER PANELBOARDS

- A. Panelboards: NEMA PB 1, distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 1. For doors more than 36 inches high, provide two latches, keyed alike.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices: Fused switches.
 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 2. External Control-Power Source: 24-V control circuit.
- G. Metering:
 1. Manufacturer shall provide all meters shown on the electrical single line.
 2. Metering shall comply with specification section: 262713 Electricity metering
 3. All metering shall be factory installed integral to the distribution panel.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker or lugs only.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 2. External Control-Power Source: 24-V control circuit.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

- F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

1. Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

- a. Inverse time-current element for low-level overloads.
- b. Instantaneous magnetic trip element for short circuits.
- c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic Trip Circuit Breakers:

- a. RMS sensing.
- b. Field-replaceable rating plug or electronic trip.
- c. Digital display of settings, trip targets, and indicated metering displays.
- d. Multi-button keypad to access programmable functions and monitored data.
- e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
- f. Integral test jack for connection to portable test set or laptop computer.
- g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).

6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).

7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

8. Subfeed Circuit Breakers: Vertically mounted.

9. MCCB Features and Accessories:

- a. Standard frame sizes, trip ratings, and number of poles.
- b. Breaker handle indicates tripped status.
- c. UL listed for reverse connection without restrictive line or load ratings.
- d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

- e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
 - h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - i. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - j. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - k. Auxiliary Contacts: One, SPDT switch Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - l. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - m. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - n. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - o. Multipole units enclosed in a single housing with a single handle.
 - p. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - q. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 - 2. Fused Switch Features and Accessories:
 - a. Standard ampere ratings and number of poles.
 - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
 - c. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.

- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:
 - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- G. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- K. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces.
- N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- P. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

- 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 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 260573.16 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
1. Measure loads during period of normal facility operations.
 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

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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. Standard-grade receptacles, 125 V, 20 A.
 - 2. USB receptacles.
 - 3. GFCI receptacles, 125 V, 20 A.
 - 4. SPD receptacles, 125 V, 20 A.
 - 5. Hospital-grade receptacles, 125 V, 20 A.
 - 6. Twist-locking receptacles.
 - 7. Pendant cord-connector devices.
 - 8. Cord and plug sets.
 - 9. Toggle switches, 120/277 V, 20 A.
 - 10. Decorator-style devices, 20 A.
 - 11. Occupancy sensors.
 - 12. Digital timer light switches.
 - 13. Wall-box dimmers.
 - 14. Wall plates.
 - 15. Floor service fittings.
 - 16. Poke-through assemblies.
 - 17. Prefabricated multioutlet assemblies.
 - 18. Service poles.

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- 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.

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.

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' packing-label 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 use.
- B. Comply with NFPA 70.
- C. Must contain less than 300 ppm lead content.
- D. Comply with NEMA WD 1.
- E. 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 requirements in this Section.
- F. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- G. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: Per device color matrix on cover sheet.
 - 1. Wiring Devices Connected to Essential Electrical System: Per device color matrix on cover sheet.
 - 2. Wall Plate Color: Per device color matrix on cover sheet.

- H. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
1. Hubbell 5342 series or approved Equal
 2. Description: Two pole, three wire, and self-grounding.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Standards: Comply with UL 498 and FS W-C-596.
- B. Weather-Resistant Duplex Receptacle, 125 V, 20 A
1. Hubbell 5342 series or approved Equal
 2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Standards: Comply with UL 498.
 5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.
- C. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A
1. Hubbell 5342 series or approved Equal
 2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Standards: Comply with UL 498.
 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 USB RECEPTACLES

- A. USB Charging Receptacles
1. Hubbell 5342 series or approved Equal
 2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
 3. USB Receptacles: Dual and quad, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
 4. Standards: Comply with UL 1310 and USB 3.0 devices.

2.4 GFCI RECEPTACLES, 125 V, 20 A

- A. Duplex GFCI Receptacles, 125 V, 20 A
1. Hubbell 5342 series or approved Equal
 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Type: Non-feed through.
 5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.5 TWIST-LOCKING RECEPTACLES

- A. Twist-Lock, Single Receptacles, 120 V, 20 A
 - 1. Configuration: NEMA WD 6, Configuration L5-20R.
 - 2. Standards: Comply with UL 498.
- B. Twist-Lock, Single Receptacles, 250 V, 20 A
 - 1. Configuration: NEMA WD 6, Configuration L6-20R.
 - 2. Standards: Comply with UL 498.
- C. Twist-Lock, Single Receptacles, 277 V, 20 A
 - 1. Configuration: NEMA WD 6, Configuration L7-20R.
 - 2. Standards: Comply with UL 498.
- D. Twist-Lock, Isolated-Ground, Single Receptacles, 125 V, 20 A
 - 1. Grounding: Equipment grounding contacts shall be connected only to 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. Configuration: NEMA WD 6, Configuration L5-20R.
 - 3. Standards: Comply with UL 498.

2.6 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.
- B. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R.
- C. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
- D. 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.
- E. Standards: Comply with FS W-C-596.

2.7 CORD AND PLUG SETS

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

2.8 STANDARD-GRADE TOGGLE SWITCHES –120V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A
 - 1. Standards: Comply with UL 20 and FS W-S-896.
 - 2. This applies to all security levels

3. Hubbell 1221 series or approved Equal
- B. Two-Pole Switches, 120/277 V, 20 A
 1. Comply with UL 20 and FS W-S-896.
 2. This applies to all security levels
 3. Hubbell 1221 series or approved Equal
- C. Three-Way Switches, 120/277 V, 20 A
 1. Comply with UL 20 and FS W-S-896.
 2. This applies to all security levels
 3. Hubbell 1221 series or approved Equal
- D. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:
 1. Description: Factory-supplied key in lieu of switch handle.
 2. Standards: Comply with UL 20 and FS W-S-896.
 3. This applies to all security levels
 4. Hubbell 1221 series or approved Equal
- E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
 1. Description: For use with mechanically held lighting contactors.
 2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 3. This applies to all security levels
 4. Hubbell 1221 series or approved Equal

2.9 OCCUPANCY SENSORS

- A. Wall Switch Sensor Light Switch, Dual Technology
 1. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
 2. Standards: Comply with UL 20.
 3. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
 4. Adjustable time delay of five 10 15 20 minutes.
 5. Able to be locked to Automatic-On mode.
 6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
 7. Connections: Provisions for connection to BAS.
 8. Connections: RJ-45 communications outlet.
 9. Connections: Integral wireless networking.
- B. Wall Sensor Light Switch, Passive Infrared
 1. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
 2. Standards: Comply with UL 20.
 3. Connections: Provisions for connection to BAS.
 4. Connections: Hard wired.
 5. Connections: Wireless.

6. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
7. Integral relay for connection to BAS.
8. Adjustable time delay of five 10 15 20 minutes.
9. Able to be locked to Automatic-On mode.
10. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

2.10 DIMMERS

- A. Wall-Box Dimmers:
1. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
 2. Control: Continuously adjustable slider; with single-pole or three-way switching.
 3. Standards: Comply with UL 1472.
 4. 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.

2.11 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.12 FLOOR SERVICE FITTINGS

- A. Flush-Type Floor Service Fittings:
1. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
 2. Compartments: Barrier separates power from voice and data communication cabling.
 3. Service Plate and Cover: Rectangular, solid brass with satin finish.
 4. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
 5. Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."
 6. Refer to drawings for floor outlet schedule.
- B. Above-Floor Service Fittings:

1. Description: Type: Modular, above-floor, dual-service units suitable for wiring method used.
2. Compartments: Barrier separates power from voice and data communication cabling.
3. Service Plate: Rectangular, solid brass with satin finish.
4. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
5. Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."

2.13 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- B. Refer to Floor assembly schedule on the drawings for model #'s
- C. Standards: Comply with scrub water exclusion requirements in UL 514.
- D. 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."
- E. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
- F. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
- G. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
- H. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, four-pair cables that comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

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 comply with 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. Pigtailling 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 device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. 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 GFCI receptacles where protection of downstream receptacles is not required.
- B. Where a GFI receptacle is shown on the floor AND a GFI breaker is also provided, the GFI breaker shall provide adequate protection for the outlet.

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.
- C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for 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 hospital-grade outlets 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 - 262726

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:
 - 1. General Requirements for Lighting Fixtures and Components
 - 2. Luminaire Reflector and Trims
 - 3. LED Lamp and Drivers
 - 4. Downlight Fixture and Components
 - 5. Exit Signs.
 - 6. Emergency Lighting.
 - 7. Equipment Identification
 - 8. Factory Applied Finish
 - 9. Performance Requirements
 - 10. Luminaire Requirements
 - 11. Materials.
 - 12. Luminaire Supports
- 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.
- C. Description of Work:
 - 1. This work consists of providing all labor, materials, accessories, mounting hardware and equipment necessary for an operationally and aesthetically complete installation of all luminaires, including power wiring, control wiring and accessories, in accordance with the contract documents.
 - 2. Coordinate with Vendors and other trades, in advance of installation work, to define all infrastructure and installation requirements. Coordinate all infrastructure requirements with all approved lighting equipment prior to infrastructure installation. This includes, but not limited to, appropriately sized, positioned, and located junction boxes, structural supports, feeds, power conduits and control conduits, and remote code-compliant power-supply enclosures.
 - 3. Provide all luminaires, as herein specified, complete with lamps, drivers, power supplies, and accessories for safe and effective operation. All fixtures shall be installed and left in an operable condition with no broken, damaged or soiled parts.

4. All luminaires, items, equipment and parts furnished and specified herein shall bear the "UL Approved" label (or other NRTL label) to indicate compliance with UL requirements. All luminaires shall be manufactured in strict accordance with the appropriate and current requirements of the National Electrical Code as verified by Underwriters Laboratories, Inc. (UL), or tested to UL standards by other nationally recognized testing laboratory (NRTL) as acceptable to Building Officials and Code Administrators International (BOCAI); the International Conference of Building Officials (ICBO); or other relevant code authority recognized by the local jurisdiction within which the project is being constructed. Such a listing shall be provided for each luminaire type, and the appropriate label or labels shall be affixed to each luminaire in a location as required by code or law. All luminaires shall be UL/NRTL listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations, as required.
5. All available finishes and colors, for each luminaire, shall be submitted to the Architect for selection during shop drawing review. Premium finishes shall be provided at no additional cost premium.
6. Specifications and drawings are intended to convey all salient features, functions and characteristics of the luminaires only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details, not usually indicated on the drawings nor specified, but that are necessary for proper execution and completion of the luminaries, shall be included, the same as if they were herein specified or indicated on the drawings.
7. The Owner, Architect and Engineer shall not be held responsible for the omission or absence of any detail, construction feature, etc. which may be required in the production of the light fixtures. The responsibility of accurately fabricating the light fixtures to the fulfillment of the specification rests with the Contractor.
8. Refer to architectural details as applicable for recessed soffitt fixtures or wherever fixture installations depend upon work of other trades. Coordinate all installations with other trades. Verify dimensions of spaces for fixtures, and if necessary, adjust lengths to assure proper fit and illumination of diffuser and/or area below.
9. Where emergency battery packs are provided with fixtures (if any), they shall be connected to an unswitched power line and wired in accordance with the manufacturer's recommendations
10. Pre-manufactured flexible wiring systems are not permitted for this project.
In accordance with the above and the criteria established herein, the Contractor is responsible for assuring the final design, fabrication and installation which fulfills the requirements of the Contract Documents.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index. A measure of the degree of color shift that objects undergo when illuminated by a lamp, compared with those same objects when illuminated by a reference source of comparable correlated color temperature (CCT)
- 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, consisting of a reflector, housing, lamp(s) and driver(s) together with the parts designed to distribute the light, to position and protect the lamp(s), and to connect the lamps to the power supply..
- H. RCR: Room cavity ratio.
- I. UL: Underwriters Laboratory.

1.4 REFERENCE STANDARDS:

- A. The publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. The publications may be referred to in the text by the basic designation only.
 - 1. American National Standards Institute (ANSI):
 - a. ANSI C62.41 - Recommended Practice in Low Power Circuits
 - b. ANSI C78 Series - Physical and Electrical Characteristics of High-Intensity Discharge Lamps
 - c. ANSI C78.377 - Specifications for the Chromaticity of Solid State Lighting Products
 - d. ANSI C81 Series - Electric Lamp Bases and Holders
 - e. ANSI C82.77 - Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment
 - f. ANSI E1.20 - Remote Device Management Over DMX512 Networks
 - g. ANSI/IES RP-16-10 - Nomenclature and Definitions for Illuminating Engineering
 - 2. Federal Communications Commission (FCC):
 - a. Code of Federal Regulations (CFR), Title 47, Part 18
 - b. Part 15 Class B: Radio Frequency Devices, Commercial Rated
 - 3. International Electrotechnical Commission (IEC):
 - a. IEC 61000-3-2 - Harmonic Current Emissions
 - b. IEC 61347-1 - General and Safety Requirements for Lamp Control Gear
 - c. IEC 61347-2-13 - Particular Requirements for Electronic Control Gear for LED Modules
 - d. IEC 61547 - EMC Immunity Requirements
 - e. IEC 62384 - DC and AC Supplied Electronic Control Gear for LED Modules - Performance Requirements
 - f. IEC 62386-101 - Digital Addressable Lighting Interface - Part 101: General Requirements – System
 - g. IEC 62386-102 - Digital Addressable Lighting Interface - Part 102: General Requirements - Control Gear
 - h. IEC 62386-207 - Digital Addressable Lighting Interface - Part 207: Particular Requirements for Control Gear - LED Modules (device type 6)
 - 4. Illuminating Engineering Society of North America (IESNA):
 - a. IES HB-10, IES Lighting Handbook – Tenth Edition
 - b. IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products, LM-79-08.
 - c. IES Approved Method for Measuring Lumen Maintenance of LED Light Sources, LM-80-08.

- d. IES Approved Method for the Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature, LM-82.
 - e. IES Projecting Long Term Lumen Maintenance of LED Light Sources, TM-21.
 - f. IES ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information, LM-63.
- 5. Institute of Electrical and Electronic Engineers (IEEE): C62.41-91 - Recommended Practice on Surge Voltage in Low Voltage AC Power Circuits
- 6. National Fire Protection Association (NFPA):
 - a. NFPA 70 - National Electrical Code (NEC), National Fire Protection Association
 - b. NFPA 101 - Life Safety Code, National Fire Protection Association
- 7. National Electrical Manufacturer's Association (NEMA):
 - a. NEMA FA1, - Outdoor Flood Lighting Equipment
 - b. NEMA SH5, - Tubular Steel, Aluminum and Prestressed Concrete Roadway Lighting Poles
 - c. NEMA SSL1 - Electronic Drivers for LED Devices, Arrays, or Systems
 - d. NEMA SSL3- High-Power White LED Binning for General Illumination
 - e. NEMA SSL7A - Phase Cut Dimming for Solid State Lighting: Basic Compatibility
 - f. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronics
 - g. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- 8. OSHA 29CFR1910.7 – Luminaires shall be listed by National Recognized Testing Laboratory Approved by United States Department of Labor.
- 9. Underwriters Laboratories, Inc. (UL):
 - a. Underwriters Laboratories (UL) Standards
 - b. Underwriters Laboratories (UL) Standard for Class 2 Power Units
 - c. Underwriters Laboratories Safety Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products, UL 8750
 - d. UL 1310 - UL Standard for Safety Class 2 Power Units
 - e. UL 1598 - Luminaries
 - f. UL 924 - Standard for Emergency Lighting and Power Equipment

1.5 ACTION SUBMITTALS

A. Equal Manufacturers

- 1. Manufacturers listed as "Equal" to the Basis of Design on the light fixture schedule shall submit product cutsheets to the Engineer ten (10) days prior to bid for final written approval. This written approval will only be issued in addendum form. "Equal" fixtures shall be of equal or better quality and performance to the fixture(s) listed with manufacturer's model numbers. Burden of proof shall be on the Contractor, Vendor and manufacturer.
- 2. Upon request by Engineer, the Contractor shall submit manufacturer's computerized horizontal illumination levels using AGI32 software in foot-candles at workplane (30" above finished floor), taken every 3 feet in every room and area. Include average maintained foot-candle levels and maximum and minimum ratio.
- 3. Sustainable Design: LEED submittals conforming to requirements listed in section 013329.02 "Sustainable design reporting – LEED v 4.

- a. Provide any of the following documentation: Greenscreen V1.2 benchmark, health product declaration (HPD), Environmental product Declaration (EPD), Pre-consumer and post-consumer recycled content, FSC certified wood, or other documentation as defined in “Sustainable design reporting” – LEED v4.
- b. Failure to provide above documentation will disqualify products where this documentation is required for LEED compliance. Reference “Sustainable Design reporting – LEED v4.
- c. Indoor Environmental quality Credits:
 - 1) Product Data for wet-applied products, indicate VOC content, emissions and volume.
 - 2) Laboratory test reports: For applicable building materials, indicate compliance with requirements for low-emitting materials
 - 3) Where applicable, provide formaldehyde-free documentation.
- d. Sustainable Design:
 - 1) LEED submittals conforming to requirements listed in section 013329.02 “Sustainable design reporting – LEED v4”
 - a) Provide any of the following documentation: NSF61 and NSF 372 Certification, or other documentation as defined in “sustainable design reporting.

B. 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. Include energy-efficiency data
7. Installation instructions.
8. Warranty: Sample copy of warranty.
9. Product data lacking sufficient detail to indicate compliance with contract documents will be rejected. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

C. 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.

- D. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
- E. 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.
- F. Samples for Verification: For each type of luminaire.
 - 1. Include Samples of luminaires and accessories to verify finish selection.
- G. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.6 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 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.
 - g. Occupancy and daylight sensor.
 - h. Ceiling-mounted fire alarm devices.
 - 7. Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.
- B. Product Certificates: For each type of luminaire.
- C. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency and / or a qualified testing agency.
- D. Sample warranty.

1.7 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.
 - 2. Submit operation and maintenance data in accordance with IECC and as specified herein, showing all light fixtures, control devices and all interconnecting control wire, conduit and associated hardware.
 - 3. Contractor shall be responsible for obtaining from his supplying light fixture manufacturers, for each type of light fixture, a recommended maintenance manual including, tools required, types of cleaners to be used and replacement parts identification list.
 - 4. Copy of warranty.

1.8 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: five 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.
 - 4. Drivers: One for every 100 of each type and rating installed.

1.9 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
 - 1. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 and NEMA unless more stringent requirements are specified or indicated.
- D. Where groups of luminaire types exhibit the same list of acceptable Manufacturers, such as downlights, accents, and wall washers, the intent is to have a final installation with the same Manufacturer's equipment across the groupings as specified for consistency of optics, aesthetics, and similarity of maintenance procedures. Mixing/matching across groups is unacceptable. This also applies to multi-phased projects with single or multiple, but related luminaire types exhibiting the same list of acceptable Manufacturers, except where products have subsequently been discontinued or significantly redesigned in size, appearance, lamping, or gear.

- E. Provide luminaires from a single manufacturer for each luminaire type.
- F. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
- B. Contractor shall provide, receive, unload, uncrate, store, protect and install lamps, luminaires and auxiliary equipment, as specified herein, in accordance with respective manufacturers' project conditions of temperature and humidity and with appropriate protection against dust and dirt. Lamps for miscellaneous equipment shall be provided and installed by the Contractor according to equipment manufacturers' guidelines. All products shall be stored in manufacturer's unopened packaging until ready for installation.

1.11 WARRANTY

- A. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- B. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- C. All luminaries, finishes, and all of its component parts, and controls shall have an unconditional five (5) year warranty from date of substantial completion. Warranty shall include all light fixtures, lamps, drivers, finishes and all components to be free from defects in materials and workmanship for a period of five (5) years from date of Owner's acceptance. Replacement of luminaries, faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.
- D. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.
- E. LED drivers: The warranty period shall not be less than ten (10) years from the date of substantial completion. The warranty shall state the malfunctioning LED driver shall be exchanged by the manufacturer and promptly shipped to the Owner. The replacement LED driver shall be identical to, or an improvement upon, the original design of the malfunctioning LED driver.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide one of the products indicated on Light Fixture Schedule. Refer to Light Fixture Schedule for manufacturers and model numbers. Basis of design for each type shall be the first fixture manufacturer and model number listed for each type.
- B. Manufacturer's catalog numbers together with the descriptions on the drawings and these specifications are indicative of required design, appearance, quality and performance. Refer any discrepancies between any of these to the Engineer for resolution prior to bid. In absence of such notice to the Engineer, provide the greater requirement as directed by the Engineer, without additional cost.
- C. All luminaires shall be DLC (Design Lights Consortium) Certified.
- D. The lighting equipment specified herein has been carefully chosen for its ability to meet the luminous environment requirements of this project. Calculations (with AGI32 or other such software) are generally performed to determine luminances, luminance ratios, and horizontal and vertical illuminances and respective ratios and to assess glare and reflected glare. In some instances, virtual reality "images" have been generated (with AGI32 or other such software) to assist the Lighting Designer, the Architect and/or the Owner in assessing the lighting quality of the space(s). Equipment and/or manufacturers which have been shown to comply with established criteria, including ASHRAE/IES 90.1 and IES guidelines and normal-power lighting requirements as applicable by ordinance, code, Federal law, mandate, or directive, and/or intended LEED certification or other building-rating system, and other lighting standards as deemed appropriate for this specific project is specified herein.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Comply with the requirements specified in the Articles below and the Light Fixture Schedule.
- B. Complete luminaires shall be in accordance with NFPA 70, NEMA, and UL 1598 listed and labeled.
- C. Provide luminaires complete with lamps of number, type, and wattage indicated.
- D. Drivers and transformers, unless otherwise specified, shall be field replaceable and shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- E. Unless otherwise specified, a dedicated means of connecting light source to power shall be used in all luminaires unless otherwise specified and shall meet all UL requirements. LED modules shall be field replaceable.
- F. Recessed fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- G. Luminaires shall be entirely factory wired by the luminaire manufacturer in accordance with code and UL requirements and shall be furnished fully compatible with the project electrical wiring and controls system for smooth, continuous, dimming or on/off flicker-free operation.
- H. Provide in-line fuse-holders with fuses sized per manufacturer's recommendation for each fixture.
- I. Provide all luminaires with a specific means for grounding their metallic wireways and housings to an equipment grounding conductor and ground accordingly upon installation.
- J. All luminaires shall be provided with a ground wire and grounded accordingly upon installation.

- K. All luminaires supplied for recessing in suspended ceilings shall be supplied with pre-wired junction boxes, unless otherwise specified.
- L. Provide “maximum wattage label” on all light fixture based on the specified maximum wattage indicated on the light fixture schedule.
- M. Metal parts: Free of burrs, sharp corners and sharp edges.
- N. Doors, frames and other internal access: Smooth operating, free of light leakage under operating conditions. Designed to prevent doors, frames, lenses, diffusers and other components from falling accidentally during maintenance and when secured during operating position.
- O. Mounting Frames and Rings: If ceiling system and luminaire type requires, each recessed and semi-recessed luminaire shall be furnished with a mounting frame or ring compatible with the ceiling in which they are to be installed as coordinated by Contractor. The frames and rings shall be one piece and of sufficient size and strength to sustain the weight of the luminaire and maintain plumb.
- P. Pendant Supports: Contractor shall be responsible for coordination with Manufacturer, Architect, Structural Engineer and related trades to ensure that proper and adequate structural reinforcement is provided within ceilings to support pendant mounted lighting equipment for a secure, neat, square, plumb appearance. Pendants shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with lamps, globes, lenses, lens frames or doors etc. in place.
- Q. Wall Bracket (Sconce) Supports: Contractor shall be responsible for coordination with Manufacturer, Architect, Structural Engineer and related trades to ensure that proper and adequate structural reinforcement is provided within walls to support wall mounted lighting equipment for a secure, neat, square, plumb appearance. Wall brackets shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with lamps, globes, lenses, lens frames or doors etc. in place.
- R. All lenses or other light diffusing elements shall be removable for access to lamp and electrical and electronic components and luminaire cleaning, however, they must otherwise be positively and securely held in-place, unless otherwise specified.
- S. There shall be no light leaks between the lens and the lens frame. All lens door or holder trim flanges shall fit plumb and flush with the ceiling or wall surface. There shall be no light leaks around the interface between lens door or holder trim flanges and the ceiling or wall.
- T. Drivers, or transformers, unless otherwise specified, shall be field replaceable and shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- U. Unless otherwise specified, a dedicated means of connecting light source to power shall be used in all luminaires unless otherwise specified and shall meet all UL requirements. LED modules shall be field replaceable.
- V. Recessed luminaires mounted in an insulated ceiling shall be listed for use in insulated ceilings or provisions made to maintain code-compliant air-space around luminaires in accordance with Vendors' instructions.
- W. Unless otherwise specified, luminaire closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- X. Unless otherwise specified, luminaires with louvers or light transmitting panels shall have hinges, latches and safety catches to facilitate safe, convenient cleaning and relamping. Vapor tight luminaires shall have pressure clamping devices in lieu of the latches.

- Y. Yokes, brackets and supplementary supporting members necessary for mounting lighting equipment shall be furnished and installed by the Contractor and approved by the Architect. All materials, accessories, and any other equipment necessary for the complete and proper installation of luminaires, lamps, ballasts/neon transformers included in the contract shall be furnished and installed by the Contractor. All yokes, brackets and supplementary supports shall provide a neat, square, plumb and level appearance, and shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with all lamps, globes, lenses, lens frames or doors etc. in place.
- Z. All connections shall be fixed rigid by screws, rivets and/or soldering. Screws and rivets shall not be visible except as necessary for maintenance and/or aesthetic appearance. Soldering shall be ground smooth to a clean, contiguous surface. All connections shall provide a neat, square, plumb and level appearance, and shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with lamps, globes, lenses, lens frames or doors etc. in place.
- AA. All sheet metal work shall be free from tool marks and dents, and shall have accurate angles bent as sharp as compatible with the gauges of the required metal and the luminaire styling. All intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly.
- BB. For steel and aluminum luminaires, all screws, bolts, nuts and other fastening and latching hardware shall be a cadmium or equivalent plated. For stainless steel luminaires, all hardware shall be stainless steel. For all bronze luminaires, all hardware shall be bronze.
- CC. Extruded aluminum frames and trims shall be rigid and manufactured from quality aluminum without blemishes in the installed product. Miter cuts shall be accurate; joints shall be flush and without burrs and cut alignment maintained with the luminaire located in its final position.
- DD. Outdoor Luminaires: Luminaires shall be suitably gasketed and vented according to manufacturer's instructions. All dissimilar metal materials shall be separated by non-conductive materials to prevent galvanic action.
- EE. Exterior building mounted light fixtures shall be UL classified for damp or wet locations as applicable and shall be complete with gaskets, cast aluminum outlet box and grounding. All dissimilar metal materials shall be separated by non-conductive materials to prevent galvanic action.

Product procurement and coordination: Contractor shall:

- 1. Order products according to application
 - 2. Confirm the proper and complete catalog number with distributor and agent.
 - 3. Ensure wiring, driver, etc meets the specifications and proper requirements.
 - 4. Provide additional parts and pieces required to complete the installation in the location and manner intended by the design.
- FF. Each light fixture shall be packaged with complete instructions and illustrations on how to install.
 - GG. Each light fixture box, container, etc shall be labeled at the factory with the type designation as indicated on the Light Fixture Schedule.
 - HH. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
 - b. UV stabilized.

2.3 LUMINAIRE REFLECTORS AND TRIMS

- A. Alzak cones, reflectors, baffles and louvers shall be warranted against discoloration.
- B. All cones, reflectors, baffles and louvers shall be removable for lamp access and luminaire cleaning; however, they must otherwise be positively and securely held in-place.
- C. All trims, reflectors and canopies shall fit snugly and securely to the ceiling or wall so that no light leak occurs.
- D. Trims shall be self-flanged and white, unless otherwise specified.
- E. For trimless or flangeless luminaires, Contractor shall coordinate with other Trades to achieve a trimless/flangeless installation acceptable to the Architect. Where ceilings are drywall or plaster, this involves Level 5 finishes or as otherwise directed by the Architect. In drywall, plaster, wood, or stone ceilings, special luminaire collars and exacting coordination are required of Contractor.

2.4 LIGHT EMITTING DIODE (LED) ELECTRONIC DRIVERS: The electronic driver shall at a minimum meet the following characteristics:

- A. LED drivers shall comply with NEMA SSL 1, NFPA 70, and UL 8750 unless otherwise specified.
- B. All LED luminaires shall use drivers integral to luminaires or as otherwise required by the luminaire manufacturer.
- C. Driver shall comply with UL 1310 Class 2 requirements for dry and damp locations, NFPA 70 unless specified otherwise. Drives shall be designed for the wattage of the LEDs used in the indicated application. Drivers shall be designed to operate on the voltage system to which they are connected.
- D. LED driver shall withstand up to a 1,000-volt surge without impairment of performance as defined by ANSI C62.41 Category A.
- E. LED driver shall tolerate ± 10 percent supply voltage fluctuation with no adverse effects to driver or LEDs.
- F. LED driver forward voltage (V_f) shall be matched to LED board.
- G. LED driver shall exhibit no visible change in light output with a variation of ± 10 percent line voltage input.
- H. Drivers for luminaires controlled by dimming devices shall be as specified herein and equipped for dimming and conform to the recommendations of the manufacturer of the associated dimming devices to assure satisfactory operation of the lighting system. Contractor shall coordinate all wiring infrastructure to accommodate final-selected drivers and controls systems for smooth, continuous, and flicker-free operation.
- I. Flicker: The flicker shall be less than 5 percent at all frequencies below 1000 Hz and without visible flicker. Drivers shall meet or exceed NEMA 410 driver inrush standard.
- J. Power factor shall be 0.95 (minimum).
- K. Class A Sound Rating.
- L. Current crest Factor of 1.5 or less.
- M. LED driver total harmonic distortion (THD) shall be less than 20 percent for drivers unless otherwise specified. For dimming drivers, THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.

- N. All LED luminaires shall be fused on the primary side of the driver as recommended by the respective luminaire manufacturers.
- O. All LED drivers shall be suitably sized to accommodate the LED array consistent with industry standards, including IEC standard 60929 Annex E.

2.5 LIGHT EMITTING DIODE (LED): The light emitting diodes shall as a minimum meet the following characteristic:

- A. LED modules shall be manufactured by Cree, GE, Philips, Osram, Niche, or Xicato.
- B. LED lamps shall comply with ANSI C78.1.
- C. Chromacity of LED lamps shall comply with ANSI C78.377A and NEMA SSL-3.
- D. Light emitting diodes shall be tested under IES LM-80 standards.
- E. Color Rendering Index (CRI) shall be 84 (minimum).
- F. Color temperature as indicated on light fixture schedule.
- G. Rated lumen maintenance of 90% lumen output at 50,000 hours (minimum).
- H. Rated lumen maintenance of 70% lumen output at 100,000 hours (minimum).
- I. Provide light fixture types that the LED boards and drivers can be re-placed from the bottom and below ceiling. Trim for the exposed surface of flush-mounted fixtures shall be white or as indicated on light fixture schedule.
- J. For color consistency, lamp maintenance consistency and for light output consistency, mixed lamps of the same lamp type from different manufacturers is unacceptable. Use the same brand and date code for all lamps except as otherwise specified. Contractor shall be responsible for coordinating all lamps and brand among all luminaire Vendor(s) and Contractor's respective distributor(s).

2.6 DOWNLIGHT FIXTURES AND COMPONENTS

- A. Downlights shall be listed for thru-branch circuit wiring, recessing in ceilings and damp locations. Where installed in plaster or drywall or other inaccessible ceiling types, they shall be UL listed for bottom access.
- B. Provide with tool-less hinged junction box access cover and thermal protection.
- C. Provide telescoping channel bar hangers that adjust vertically and horizontally.

2.7 EXIT SIGNS

- A. General requirements: UL 924, NFPA 70, AND NFPA 101. Exit signs shall use no more than 5 watts. Housing shall be made of die-cast aluminum. Provide stencil face and lettering.
- B. Provide single or double face as scheduled, indicated on plans or as required by the local Authority Having Jurisdiction. Adjust installation position if required for clear visibility, in accordance with applicable codes.
- C. Housings and canopies shall be die-cast aluminum or corrosion resistant steel. Mountings shall be wall or ceiling, universal type, to suit the installation conditions. Coordinate with Architectural plans and general trades prior to ordering.

- D. Complete unit to be finished in color as selected by the Architect and / or luminaire schedule.
- E. Provide directional arrows (chevrons) as indicated on floor plans and to suit the means of egress or as required by the local Authority Having Jurisdiction.
- F. Exit signs That are hatched or where the fixture type contains the suffix "E" for emergency operation, the fixture shall have an integral 90 minute battery inverter if not powered from an emergency generator.
- G. Where emergency backup battery packs are provided with exit lights, they shall have capacities for continuous operation per applicable codes. They shall have reserve battery capacity to operate remote lamps where indicated.

2.8 EMERGENCY LIGHTING

- A. All emergency powered fixtures shall have test switches factory installed integral to the reflector - no remote test switches will be accepted.
- B. Emergency lights that are hatched or where the fixture type contains the suffix "E" or "EM" for emergency operation, the fixture shall be powered from the emergency generator.

2.9 EQUIPMENT IDENTIFICATION

- A. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
- B. Factory-Applied Labels: Provide labeled luminaires in accordance with UL 1598 requirements. All light fixtures shall be clearly marked for operation of specific LED's and drivers according to proper type. The following characteristics shall be noted in the format "Use Only ____":
 - 1. LED or lamp type, and nominal wattage
 - 2. Driver type
 - 3. Correlated color temperature (CCT) and color rendering index (CRI)
 - 4. All markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Drivers shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.10 FACTORY APPLIED FINISH

- A. Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

2.11 PERFORMANCE REQUIREMENTS

- A. Seismic Performance:
 - 1. Luminaires shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
 - 2. Luminaires and lamps shall be labeled vibration and shock resistant.

3. 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."
- B. Ambient Temperature: 5 to 104 deg F (Minus 15 to plus 40 deg C).
 1. Relative Humidity: Zero to 95 percent.
- C. Altitude: Sea level to 1000 feet Insert altitude.

2.12 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

2.13 MATERIALS

- A. Metal Parts:
 1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Steel:
 1. ASTM A36/A36M for carbon structural steel.
 2. ASTM A568/A568M for sheet steel.
- C. Stainless Steel:
 1. Manufacturer's standard grade.
 2. Manufacturer's standard type, ASTM A240/240M.
- D. Galvanized Steel: ASTM A653/A653M.

- E. Aluminum: ASTM B209.

2.14 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.

2.15 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 A641/A641M, 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.
- F. Straps: Galvanized steel, one by 3/16 inch, conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.
- G. Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Hangers shall allow fixtures to swing within an angle of 45 degrees. Brace pendants 4 feet or longer to limit swinging. Single-unit suspended fixtures shall have twin-stem hangers. Multiple-unit or continuous row fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 0.18 inch diameter.
- H. All suspended luminaires with a weight in excess of 150 pounds shall be fitted with safety cable of sufficient strength and length to meet all UL safety cable load-bearing requirements. Cable shall exhibit a finish (but not painted) compatible with that of the metal finish of the stem/chain/suspension-cable assembly or alternatively finished in black as approved by Architect. Shop drawings shall indicate luminaire weight. Contractor shall coordinate structural support/attachment requirements including independent structure for safety cable attachment with Vendor, Architect, and Structural Engineer and all respective trades. Safety cable shall exhibit sufficient length to wrap tightly and entirely around structural member at least twice before attachment subject to Vendor confirmation of UL requirements and pending Structural Engineer review. Contractor shall provide labor necessary for the stem/chain-assembly-wiring-threading and safety-cable-attachment as instructed by Vendor.

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.
- C. 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. Architect's reflected ceiling plan (RCP) shows actual locations of all light fixtures, diffusers and system devices. Report to the Architect/Engineer any conflicts. Do not scale plans for exact location of lighting fixtures.
- B. Install luminaires in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", and NEMA standards.
- C. Electrical installations shall conform to and meet IEEE C2, NFPA 70, and to the requirements specified herein.
- D. Installed luminaires shall be provided with protective covering by Contractor until such time as the space(s) is cleaned and ready for occupancy.
- E. Align, mount and level the luminaires uniformly. All luminaires shall be installed plumb/true and level as viewed from all directions. Luminaires shall remain plumb and true without continual adjustment.
- F. The Contractor shall coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, pipes, steel, etc. Avoid interference with and provide clearance for equipment.
- G. Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.
- H. Recessed and semi-recessed fixtures shall be independently supported from the buildings structure by a minimum of four wires per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Round fixtures or fixtures smaller in size than the ceiling grid shall be independently supported

from the building structure by a minimum of four wires per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires for lighting fixture support in this section.

- I. Lighting Fixture Supports:
 - 1. Shall provide support for all of the fixtures.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the luminaires without causing the ceiling or partition to deflect
 - 4. For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system.
- J. Luminaires installed and used for working light during construction shall be replaced prior to turnover to the Owner if more than 3 percent of their rated life has been used. Fixtures shall be tested for proper operation prior to turn-over and shall be replaced if necessary, with new lamps from the original manufacturer.
- K. Suspended fixtures shall hang plumb and shall be located with no obstructions within the 45-degree range in all directions. The stem, cable, canopy and fixture shall be capable of 45-degree swing. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown.
- L. Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, a finishing ring painted to match the ceiling, shall be used to conceal the junction box.
- M. Rigidly align continuous rows of light fixtures for true in-line appearance.
- N. Exit Signs and Emergency Lighting Units: Wire exit signs ahead of the switch to the un-switched emergency lighting life-safety branch circuit located in the same room or area.
- O. Light fixture whips shall be supported from the building structure. Do not clip to lay-in ceiling support wires.
- P. Exterior Fixtures:
 - 1. Exterior building mounted light fixtures shall not be installed until after the building exterior has been rinsed clean of any corrosive cleaning materials. Damaged fixtures shall be replaced by the Contractor at no cost.
 - 2. Provide exterior rated waterproof junction boxes for all fixtures and splices.
 - 3. Utilize weatherproof silicone filled wire nuts and seal all junction boxes and conduit with potting compound to create waterproof barriers. Inspect all splices and fixtures for continuity prior to potting.
 - 4. Lubricate all threaded parts with a high temperature waterproof anti-seize lubricant, including lamp bases and sockets, to prevent seizing and corrosion.
 - 5. All low-voltage wiring to be UV resistant, UL approved for use without conduit, stranded low-voltage wire (Q-Wire by Q-Tran or equal) for use in outdoor and underground applications, gauge as appropriate to avoid voltage drop.

6. Track Lighting: The Electrical Contractor shall allow for all track lighting to be wired with individual home runs (not looped) so invisible feeds (no junction box at end of track) may be utilized.
- Q. Transformers (applies to all transformers including (but not limited to) low voltage, neon, remote ballast, LED power supplies, exterior locations):
 1. Electrical Contractor to locate all transformers (including low voltage, neon, remote ballasts, led power supplies, etc.) near fixtures in a well-ventilated and accessible location. Transformers must be installed (per codes) in accessible areas large enough to dissipate the heat of the transformer. Temperatures should not exceed 100°F (38°C).
 2. Transformers should be mounted as close to the load/feed lamp holders as practical to keep the secondary feeds as short as possible.
 3. Electrical Contractor to determine wire size according to load and wire length to eliminate voltage drop. If voltage drop is a problem after installation, the Electrical Contractor is responsible for reinstallation (at no additional cost) of transformer and wire to solve problem.
 4. Electrical Contractor to label front of transformer with load name and load location. For example: "Large Display Case @ Entry to Main Dining Room."
- R. Light fixture locations in mechanical and electrical equipment rooms/areas, as indicated on floor plans, are approximate. Locate light fixtures to avoid equipment, ductwork, and piping. Locate around and between equipment to maximize the available light. Coordinate mounting heights and locations of light fixtures to clear equipment. Request a meeting with the Engineer if uncertain about an installation. All suspended light fixtures shall be mounted square and plumb.
- S. Contractor shall be responsible for sealing all luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) to prevent water wicking.
- T. Coordinate between the electrical and ceiling trades to ascertain that approved luminaires are furnished in the proper sizes, with the proper flange details, and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.
- U. All reflecting surfaces, glass or plastic lenses, driver housings, parabolic louvers, downlighting alzak cones and specular reflectors and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.
- V. Handle all reflecting surfaces, glass or plastic lenses, driver housings, parabolic louvers, downlighting alzak cones and specular reflectors and other decorative elements with care during installation or lamping to avoid fingerprints or dirt deposits.
- W. It is preferred that louvers be shipped and installed with clear plastic bags to protect louvers. At close of project, and after construction air filters are changed, remove bags.

3.4 GROUNDING

- A. Bond luminaires and metal accessories to the grounding system per National Electrical Code.
- B. Ground noncurrent-carrying parts of equipment including luminaires, mounting arms, brackets, and metallic enclosures. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.5 IDENTIFICATION

- A. Light fixtures served from multiple power sources, such as emergency fixtures fed from emergency transfer relay, shall have the following label affixed to it:

1. "DANGER - ELECTRICAL SHOCK HAZARD - LIGHT FIXTURE HAS MULTIPLE POWER SOURCES"
- B. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.6 CLEANING

- A. At completion of each phase and the time of final acceptance by the Owner, all lighting fixtures shall have been thoroughly cleaned with materials and methods recommended by the manufacturer.
- B. Any louver or cone showing dirt or fingerprints shall be cleaned with solvent recommended by the manufacturer to a like-new condition, or replaced as necessary in order to turn over to the Owner new fixtures at beneficial occupancy.
- C. All fingerprints, dirt, tar, smudges, drywall mud and dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens/louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any.

3.7 TESTING AND ADJUSTMENT

- A. The lighting and lighting controls systems shall be synchronized and fully operable to address the lighting operation in a complete and code-compliant manner.
- B. All adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Architect. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.
- C. Contractor shall coordinate with Architect to establish the number of two-member crews required for aiming and adjusting. All aiming and adjusting shall be performed after the entire installation is complete for each phase or area. The Contractor shall be responsible for notifying the Architect of appropriate time for final luminaire adjustment.
- D. All ladders, scaffolds, lifts, gloves, cleaning cloths, access/adjustment tools, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- E. Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.8 FIELD QUALITY CONTROL:

- A. Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.
- B. Dimming Drivers. Test for full range of dimming capability. Observe for visually detectable flicker over full dimming range.
- C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- D. Inspect each light fixture for damage. Replace damaged light fixtures at no cost to the Owner.
- 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 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to four (4) visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION - 265119

SECTION 270502 – SCOPE OF THE COMMUNICATIONS WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. All layout and installation of communications infrastructure shall be in accordance with ANSI / TIA 568 and the BICSI TDMM.
- D. Each Contractor's attention is directed to Section 260010 – General Requirements for Electrical Systems as they apply to their work.
- E. Each Contractor's attention is directed to Section 260500 – Common Work Results for Electrical Systems as they apply to their work.

1.2 SCOPE OF THE ELECTRICAL WORK

- A. The Communications work for this project includes all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, verify place in service and deliver to the Owner a complete Communications system in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include, but is not limited to the following:
 - 1. All communications devices and device plates.
 - 2. Cable splicing, terminations, supports, etc.
 - 3. Pathways and raceways for Voice/Data system shall be in accordance with Division 26 and 27 Specifications. Pathways and raceways shall be provided and installed by Division 26 Contractor. All other Division 27 infrastructure shall be provided by the Division 27 contractor.
 - 4. Testing of all cabling and devices installed shall be by the Division 27 Contractor.
 - 5. All necessary coordination with the Owner, telephone company, cable television company, etc. to ensure that work, connections, etc., that they are to provide is accomplished and that service to this facility is delivered complete prior to occupancy.
 - 6. Inspection of Division 27 systems shall be from a Licensed Electrical Inspector and paid for by the Division 27 Contractor.

END OF SECTION – 270502

SECTION 270503 – SHOP DRAWINGS, MANUALS, PARTS LISTS AND SPECIAL TOOLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. All layout and installation of communications infrastructure shall be in accordance with ANSI / TIA 568 and the BICSI TDMM.
- D. Each Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Each Contractor shall submit to the Architect and/or Engineer, within thirty days after the date of the Contract, one set of shop drawings and/or manufacturer's descriptive literature on all equipment required for the fulfillment of his contract via eComm. Each shop drawing and/or manufacturer's descriptive literature shall have proper notation indicated on it and shall be clearly referenced so the specifications, schedules, light fixture numbers, panel names and numbers, etc., so that the Architect and/or Engineer may readily determine the particular item the Contractor proposes to furnish. All data and information scheduled, noted or specified by hand shall be noted in color red on the submittals. The Contractor shall make any corrections or changes required and shall resubmit for final review as requested. Review of such drawings, descriptive literature and/or schedules shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless they have, in writing, directed the reviewer's attention to such deviations at the time of submission of drawings, literature and manuals; nor shall it relieve them from responsibility for errors or omissions of any nature in shop drawings, literature and manuals. The term "as specified" will not be accepted.
- B. If the Contractor fails to comply with the requirements set forth above, the Architect and/or Engineer shall have the option of selecting any or all items listed in the specifications or on the drawings, and the Contractor will be required to provide all materials in accordance with this list.
- C. Review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the contract documents. In all cases, the installing Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.
- D. The Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for the adaptability of the equipment or materials to the project, compliance with applicable codes, rules, regulations, information that pertains to

fabrication and installation, dimensions and quantities, electrical characteristics, and coordination of the work with all other trades involved in this project.

- E. No cutting, fitting, rough-in, connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractors concerned. It shall be each Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. Each Contractor shall coordinate with all the other Contractors having any connections, roughing-in, etc., to the equipment, to make certain proper fit, space coordination, voltage and phase relationships are accomplished.

1.3 SHOP DRAWING

- A. In accord with the provisions specified hereinbefore, shop drawings, descriptive literature and schedules shall be submitted on each of the following indicated items as well as any equipment or systems deemed necessary by the Engineer:
 - 1. Raceways
 - 2. Cable/ladder tray and each type of cable tray fitting.
 - 3. Backboxes
 - 4. Data/voice/video wallplates, each by type. Any special items not listed above.
- B. Systems
 - 1. Data/Voice Network.
 - 2. Note: Each system submittal is to be complete with legible cutsheets for all devices, equipment, special wiring, etc. Include system specific wiring schematics showing each device and its specific interconnect/wiring requirements. For rack mounted equipment, provide a scalable elevation drawing with proposed component locations & specific interconnect wiring requirements for each component/panel. Also provide scale building specific layout drawings that indicate device placement, wiring, etc. Refer to the specific system's specification for additional submittal requirements where required.
- C. Miscellaneous
 - 1. Control panel assemblies.
 - 2. Non-standard junction/pullboxes.
 - 3. Floor plan and riser drawings that show the location of all communication devices and systems.
 - 4. Floor plan and riser drawings that show the location of all low-voltage devices and systems.

1.4 SPECIAL WRENCHES, TOOLS, AND KEYS

- A. Each Contractor shall provide, along with the equipment provided, any special wrenches or tools necessary to dismantle or service equipment or appliances installed by him. Wrenches shall include necessary keys, handles and operators for valves, switches, breakers, etc. and keys to electrical panels, emergency generators, alarm pull boxes and panels, etc. At least two of any such special wrench, keys, etc. shall be turned over to the Architect prior to completion of the project. Obtain a receipt that this has been accomplished and forward a copy to the Engineer.

1.5 MAINTENANCE AND OPERATION MANUALS

- A. Upon substantial completion of the project, the Contractor shall deliver to the Engineers (in addition to the required Shop Drawings) three (3) complete hard copies and a digital copy of operation and maintenance instructions and parts lists for all equipment provided. Formatting and content shall follow the guidelines outlined in the latest version of ASHRAE Application Handbook, Guideline 4. As a minimum, the following shall be included:
1. The operation and maintenance document directory should provide easy access and be well organized and clearly identified.
 2. Emergency information should be immediately available during emergencies and should include emergency and staff and/or agency notification procedures.
 3. The operating manual should contain the following information:
 - a. General Information
 - 1) Building function
 - 2) Building description
 - 3) Operating standards and logs
 - b. Technical Information
 - 1) System description
 - 2) Operating routines and procedures
 - 3) Seasonal start-up and shutdown
 - 4) Special procedures
 - 5) Basic troubleshooting
 4. The maintenance manual should contain the following information:
 - a. Equipment data sheets
 - 1) Operating and nameplate data
 - 2) Warranty
 - b. Maintenance program information
 - 1) Manufacturer's installation, operation, and maintenance instructions
 - 2) Spare parts information
 - 3) Preventive maintenance actions
 - 4) Schedule of actions
 - 5) Action description
 - 6) History

END OF SECTION – 270503

SECTION 270504 – SLEEVING, CUTTING, PATCHING AND REPAIRING FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. All layout and installation of communications infrastructure shall be in accordance with ANSI / TIA 568 and the BICSI TDM.
- D. Each Contractor's attention is directed to Section 260500 – Common Work Results for Electrical Systems as they apply to their work.
- E. Each Contractor's attention is directed to Section 260010 – General Requirements for Electrical Systems as they apply to their work.

1.2 ACTION SUBMITTALS

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

1.3 SUMMARY

- A. The Contractor shall be responsible for all openings, sleeves, trenches, etc. that he may require in floors, roofs, ceilings, walls, etc. and shall coordinate all such work with the Construction Manager, General Contractor and all other trades. He shall determine and coordinate any openings which he is to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the responsible Contractor.
- B. The Contractor shall plan his work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for conduit, conductors, wireways, etc. to go through; however, when this is not done, this Contractor shall do all cutting and patching required for the installation of his work, or he shall pay other trades for doing this work when so directed by the Architect. Any damage caused to the buildings by the workmen of the responsible Contractor must be corrected or rectified by him at his own expense.
- C. The Contractor shall cut holes in casework, equipment panels, etc. (if any), as required to pass pipes in and out.

- D. The Contractor shall notify other trades in due time where he will require openings of chases in new concrete or masonry. He shall set all concrete inserts and sleeves for his work. Failing to do this, he shall cut openings for his work and patch same as required at his own expense.
- E. Openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe cut with a masonry saw.
- F. Where sleeves are placed in exterior walls below grade, the space between the pipe or conduit and the sleeves shall be made completely water tight. Provide Crouse-Hinds Link-Seal Environmental Conduit Seal with stainless steel hardware. Alternative methods shall be approved by the Engineer and/or Architect during shop drawing review.
- G. In all cases, sleeves shall be at least two pipe sizes larger than nominal pipe diameter.
- H. All roof penetrations shall be made inside mechanical equipment curbs, UON.
- I. Sleeves passing through roof or exterior wall or where there is a possibility of water leakage and damage shall be caulked water tight for horizontal sleeves and flashed and counter-flashed with lead (4 lb.) or copper and soldered to the piping, lapped over sleeve and properly weather sealed.
- J. All rectangular or special shaped openings in plaster, stucco or similar materials including gypsum board shall be framed by means of plaster frames, casing beads, wood or metal angle members as required. The intent of this requirements is to provide smooth even termination of wall, floor and ceiling finishes as well as to provide a fastening means for lighting fixtures, panels, etc. Lintels shall be provided where indicated over all openings in bearing walls, etc.
- K. No cutting is to be done at points or in a manner that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Architect and Structural Engineer.
- L. The Contractor shall be responsible for properly shoring, bracing, supporting, etc. any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements, shall be promptly and properly made good to the satisfaction of the Architect.
- M. All work improperly done or not done at all as required by the Electrical trades in this section will be performed by the Contractor at the direction of the trade whose work is affected. The cost of this work shall be paid for by the Contractor who is in non-compliance with the Contract.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, 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. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
 - a. Minimum Metal Thickness: Shall be 0.138 inch (10 gauge).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. The Contractor shall provide and locate all sleeves and inserts required for his work before the floors and surface being penetrated are built, otherwise the Contractor shall core drill for conduits where sleeves and inserts were not installed, or where incorrectly located. Core drilling is the only acceptable alternative to sleeves. Do not chisel openings. Where sleeves are placed in exterior walls or in slabs on grade, the space between the conduit and the sleeves shall be made completely and permanently water tight.
- D. Conduits that penetrate fire and/or smoke rated assemblies shall have sleeves installed as required by the manufacturer of the rating seal used.
- E. Fasten sleeves securely in floors, walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into the space between pipe and sleeve during construction.
- F. Sleeves in floors shall extend 1" above finished floor level.
- G. Escutcheon plates shall be provided for all conduits passing thru walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the conduit. Where plates are provided for conduits passing thru sleeves which extend above the floor surface, provide deep recessed plates to conceal the conduit sleeves.
- H. In all areas where busducts are exposed and pass thru floors, the opening shall be surrounded by a 4 inch high by 3 inch wide concrete curb.

3.2 CUTTING

- A. No cutting is to be done at points or in a manner that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Engineer.
- B. Conduit openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe cut with a masonry saw.
- C. Openings in metal building walls shall be made in strict accord with building suppliers recommendations.

3.3 PATCHING AND REPAIRING

- A. Patching and repairing made necessary by work performed under this division shall be included as a part of the work and shall be done by skilled mechanics of the trade or trades for work cut or damaged, in strict accordance with the provisions herein before specified for work of like type to match adjacent surfaces and in a manner acceptable to the Engineer.

- B. Where portions of existing lawns, shrubs, paving, etc. are disturbed for installation of work of this Division, such items shall be repaired and/or replaced to the satisfaction of the Engineer.
- C. Where the installation of conduit, raceways, etc. requires the penetration of fire or smoke rated walls, ceilings or floors, the space around such conduit, raceways, etc., shall be tightly filled with an approved non-combustible fire insulating material satisfactory to maintain the rating integrity of the wall, floor or ceilings affected.
- D. Conduits passing through floors, ceilings and walls in finished areas, unless otherwise specified, shall be fitted with chrome plated brass escutcheons of sufficient outside diameter to amply cover the sleeved openings and an inside diameter to closely fit the conduit around which it is installed.
- E. Stainless steel collars shall be provided around all conduits, raceways, etc., at all wall penetrations; both sides where exposed.
- F. Where conduits pass through interior or exterior walls, the wall openings shall be sealed air tight. This shall include sealing on both sides of the wall to insure air does not enter or exit the wall cavity. This is especially critical on exterior walls where the wall cavity may be vented to the exterior.

END OF SECTION – 270504

SECTION 270508 – COORDINATION AMONG TRADES, SYSTEMS INTERFACING AND CONNECTION OF EQUIPMENT FURNISHED BY OTHERS FOR COMMUNICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. All layout and installation of communications infrastructure shall be in accordance with ANSI / TIA 568 and the BICSI TDMM.
- D. Each Contractor's attention is directed to Section 260500 – Common Work Results for Electrical Systems as they apply to their work.
- E. Each Contractor's attention is directed to Section 260010 – General Requirements for Electrical Systems as they apply to their work.

1.2 COORDINATION

- A. The Contractor is expressly directed to read the General Conditions and all sections of these specifications for all other trades and to study all drawings applicable to his work, including Architectural, Plumbing Fire Protection, Mechanical and Structural drawings, to the end that complete coordination between trades will be affected. Each Contractor shall make known to all other contractors the intended positioning of materials, raceways, supports, equipment and the intended order of his work. Coordinate all work with other trades and proceed with the installation in a manner that will not create delays for other trades or affect the Owner's operations.
- B. Special attention to coordination shall be given to points where raceways, fixtures, etc., must cross other ducts or conduit, where lighting fixtures must be recessed in ceilings, and where fixtures, conduit and devices must recess into walls, soffits, columns, etc. It shall be the responsibility of each Contractor to leave the necessary room for other trades. No extra compensation or time will be allowed to cover the cost of removing fixtures, devices, conduit, ducts, etc. or equipment found encroaching on space required by others.
- C. The Contractor shall be responsible for coordination with all trades to ensure that they have made provision for connections, operational switches, disconnect switches, fused disconnects, etc., for electrically operated equipment provided under this or any other division of the specifications, or as called for on the drawings. Any connection, circuiting, disconnects, fuses, etc. that are required for equipment operation shall be provided as a part of this contract.
- D. If any discrepancies occur between accompanying drawings and these specifications and drawings and specifications covering other trade's work, each trade shall report such discrepancies to the Architect far enough in advance so that a workable solution can be

presented. No extra payment will be allowed for relocation of fixtures, devices, conduit, and equipment not installed or connected in accordance with the above instructions.

- E. In all areas where air diffusers, devices, lighting fixtures and other ceiling-mounted devices are to be installed, the Mechanical Trade(s), the Electrical Trade and the General Trades shall coordinate their respective construction and installations so as to provide a combined symmetrical arrangement that is acceptable to the Architect and Engineer. Where applicable, refer to reflected ceiling plans. Request layouts from the Architect or Engineer where in doubt about the potential acceptability of an installation.

1.3 INTERFACING

- A. Each Electrical Trade, Specialty Controls Trade, Mechanical Trade and the General Trades, etc., shall insure that coordination is effected relative to interfacing of all systems. Some typical interface points are (but not necessarily all):
 - 1. Connection of all controls to equipment.
 - 2. Electrical power connections to electrically operated (or controlled) equipment.
 - 3. Electrical provisions for all equipment provided by other trades or suppliers within this contract.
 - 4. Contractor is to provide conduit whips and back boxes, as needed, for systems furniture.
 - 5. Coordination of connection of Telecommunications (voice, data, video) lines.

1.4 CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

- A. Each Contractor shall make all connections to equipment furnished by others, whenever such equipment is shown on any part of the drawings or mentioned in any part of the Specifications, unless otherwise specifically specified hereinafter.
- B. All drawings are complementary, one trade of the other. It is the Contractor's responsibility to examine all drawings and specifications to determine the full scope of his work. The project Engineers have arranged the specifications and drawings in their given order solely as a convenience in organizing the project, and in no way shall they imply the assignment of work to specific trades, contractors, subcontractors or suppliers.
- C. Supervision to assure proper installation, functioning and operation shall be provided by the Contractor furnishing the equipment or apparatus to be connected.
- D. Items indicated on the drawings as rough-in only (RIO) will be connected by the equipment supplier or Owner, as indicated. The Contractor shall be responsible for rough-in provisions only as indicated. These rough-ins shall be in accord with the manufacturer's or supplier's requirements.
- E. For items furnished by others, relocated, or RIO, the Contractor shall obtain from the supplier or shall field determine as appropriate, the exact rough-in locations and connection sizes for the referenced equipment.
- F. The Contractor shall be responsible for coordinating with the General and all other trades, as necessary, to determine any and all final connections that he is to make to equipment furnished by others.
- G. Sides of cable, basket and ladder trays shall not be obstructed with special attention to pipes, ductwork, raceways, equipment, cables, etc.

END OF SECTION – 270508

SECTION 270526 – GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, Section 260010 “General Requirements for Electrical”, and 270502 “Scope of Communications Work” apply to this Section.

1.2 SUMMARY

- A. Description: The telecommunications bonding and grounding system and its interconnections to the electrical system provide an electrically continuous, low impedance path for all connected telecommunications equipment and pathways.
- B. Section Includes:
 - 1. Bonding conductors.
 - 2. Bonding connectors.
 - 3. Bonding busbars.
- C. Related Requirements:
 - 1. Refer to Section 260526 “Grounding and Bonding for Electrical Systems” for requirements associated with Electrical System Grounding, Equipment Grounding System, and Grounding Electrode System.

1.3 REFERENCES

- A. Abbreviations
 - 1. TBC: Telecommunications Bonding Conductor.
 - 2. SBB: Secondary Bonding Busbar (Formerly TGB).
 - 3. PBB: Primary Bonding Busbar (Formerly TMGB).
 - 4. RBB: Rack Bonding Busbar
 - 5. TBB: Telecommunications Bonding Backbone
 - 6. BBC: Backbone Bonding Conductor
 - 7. TEBC: Telecommunications Equipment Bonding Conductor
 - 8. RBC: Rack Bonding Conductor
- B. Definitions
 - 1. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.
 - 2. Grounding: Establishing a direct or indirect connection to Earth or some conducting body that serves in place of Earth.

3. Bonding: Method by which all non-energized conductive materials are effectively interconnected to create a low impedance path.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 1. Building Industry Consulting Service International (BICSI)
 - a. ANSI/BICSI N3-20 "Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure"

1.4 SUBMITTALS

- A. Product Data: For each type of product.
- B. Field Quality Control Reports: Provide test reports for each test specified in the field quality control section. Include certificate of current equipment calibration.
- C. Closeout Submittals:
 1. Operation and Maintenance Data: In addition to the items specified in Division 01 and Section 260010 "General Requirements for Electrical" include the following:
 - a. Results of the ground-resistance and bonding resistance tests.
 - b. Include recommended testing intervals

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with NFPA 70, TIA-607, and ANSI/BICSI N3.

2.2 CONDUCTORS

- A. Insulated Copper Conductors: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables".
 1. Ground wire for custom-length equipment bonding jumpers: minimum No. 6 AWG.

2.3 CONNECTORS

- A. Comply with requirements in 260526 "Grounding and Bonding for Electrical Systems".

2.4 TELECOM BONDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
 - 1. Harger Lightning and Grounding
 - 2. Panduit Corp.
 - 3. Erico
 - 4. Chatsworth CPI
 - 5. Ortronics
 - 6. Eaton
- B. General Requirements:
 - 1. Predrilled BICSI/TIA-607 style hole pattern for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide a minimum of 4-inch clearance to access the rear of the busbar. Provide stainless steel brackets and bolts.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
 - 4. Busbar length: Size to accommodate initial conductors plus a 50% growth factor.
- C. Primary Bonding Busbar (PBB): Predrilled, wall-mounted, rectangular bars of electro-tin plated copper, 1/4 by 4 inches in cross section, minimum 24 inches in length or as indicated on Drawings. NRTL listed for use as PBB, complying with UL 467 and TIA-607.
- D. Secondary Bonding Busbar (SBB): Predrilled, wall-mounted rectangular bars of electro-tin plated copper, 1/4 by 2 inches in cross section, minimum 12 inches in length or as indicated on Drawings. NRTL listed for use as a SBB, complying with UL 467 and TIA-607.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of TBC connection.
- C. Prepare written report, endorsed by Installer, listing any conditions detrimental to performance of the Work.
- D. Proceed with connection of the TBC only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

- B. Comply with NECA 1.
- C. Comply with NFPA 70, TIA-607, and ANSI/BICSI N3.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the PBB/SBB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. 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.
- C. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- D. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than ten times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch intervals.
 - 4. Install grounding and bonding conductors in minimum 1-inch Schedule 80 PVC conduit where exposed to physical damage or where routed through building walls or footings. Provide EMT conduit for the grounding and bonding conductor pathway where installed in a plenum.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit bond the conductor to the conduit at both ends using a grounding bushing that complies with requirements.

3.4 GROUNDING ELECTRODE SYSTEM

- A. Provide a Telecommunications Bonding Conductor (TBC) between the PBB and the electrical service equipment ground busbar no smaller than No. 1/0 AWG and no smaller than the Telecommunications Bonding Backbone (TBB).
- B. Where external equipment ground busbar is not available, provide intersystem bonding termination (IBT) device for connecting telecommunications bonding conductor (TBC) with service busbar.
- C. Comply with requirements in article 250.94 of the National Electric Code (NEC)

3.5 TELECOM BONDING BUSBARS

- A. Provide PBB in main telecommunications equipment room and locate to minimize length of TBC.
- B. Provide SBB in each telecom room.
- C. Install PBB/SBB horizontally, on insulated spacers 4 inches minimum from wall, 48 inches above finished floor unless otherwise indicated.
- D. Install RBB on rack or cabinet using stand-off block insulators to provide a minimum of 0.75 inches of separation for dissimilar metals and to facilitate conductor attachment to RBB. The RBB may be directly mounted/bonded to the rack or cabinet only if doing so allows adequate space for attaching grounding conductors and does not create a dissimilar metals reaction.

3.6 CONNECTIONS

- A. Bond all metallic equipment and pathways in each telecommunications room to the bonding busbar in that room, using insulated grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pre-twist the conductor.
- D. Clean and apply an antioxidant compound to all bolted and compression connections.
- E. Building Entrance Protectors: Bond to the PBB/SBB with insulated bonding conductor.
- F. Busbar Interconnections: Interconnect all SBBs with the PBB using a continuous telecommunications bonding backbone (TBB). If more than one TBB is installed, interconnect TBBs using the backbone bonding conductor (BBC) conductor at the top floor and at every third floor in between. The telecommunications bonding backbone and backbone bonding conductor size shall not be less than 2 kmils/linear foot of conductor length, up to a maximum size of 750 kcmil unless otherwise indicated.
- G. Telecommunications Enclosures and Equipment Racks/Cabinets: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Connect the Telecommunications Equipment Bonding Conductor (TEBC) to the Rack Bonding Busbar (RBB) and to the rack/cabinet using a Rack Bonding Conductor (RBC) and listed compression two hole lugs.
- H. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each SBB and PBB to the vertical steel of the building frame.

- I. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each PBB/SBB to the equipment ground bar of the panelboard.
- J. Shielded Cable: Bond the shield of shielded cable to the PBB/SBB in communications rooms and spaces. Comply with TIA-568.1 and TIA-568-.2 when grounding shielded balanced twisted-pair cables.
- K. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the rack bonding busbar (RBB) using unit bonding conductors (UBC). Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- L. Ladder Rack and Cable Tray: Bond ladder rack/cable tray system to the PBB/SBB using manufacturer approved ground lugs and bonding conductors. Remove paint from the ladder rack/cable tray to ensure ground lugs contact bare metal.
- M. Metallic Conduits: In telecommunications rooms, bond metallic conduits longer than 24-inches to the PBB/SBB using insulated ground bushing sized for the conduit and ground conductor to be attached.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Bond Resistance Test: Test the bonding connections of the system using a certified micro-ohmmeter, taking two-point bonding measurements in each telecommunications equipment room containing a PBB/SBB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the following:
 - 1) Each PBB/SBB to the nearest electrical equipment ground.
 - 2) Each PBB/SBB to the structural steel.
 - 3) PBB to each SBB.
 - 4) Structural steel to the electrical ground.
 - b. The maximum acceptable value of this bonding resistance is 100 milliohms.
 - 3. Test for ground loop leakage currents using a certified digital clamp-on earth ground tester, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the PBB and in each SBB. Maximum acceptable ac current level is 1 A.
- B. Excessive Ground Resistance: If resistance to ground at the TBC exceeds 5 ohms, notify Engineer promptly and include recommendations to reduce ground resistance.
- C. Grounding system will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.

END OF SECTION – 270526

SECTION 270536 – CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. All layout and installation of communications infrastructure shall be in accordance with ANSI / TIA 568 and the BICSI TDMM.

1.2 SUMMARY

- A. Section Includes: Ladder cable trays.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - 2. Vertical and horizontal offsets and transitions.
 - 3. Clearances for access above and to side of cable trays.

- 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Field quality-control reports.

1.5 WARRANTY

- A. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- B. All cable trays, finishes, and all of its component parts shall have an unconditional one (1) year warranty. Warranty shall include finishes and all components to be free from defects in materials and workmanship for a period of one (1) year from date of Owner's acceptance. Replacement of cable tray, temporary support of cables, faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.
- C. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.

1.6 WARRANTIES

- A. **INSTALLATION WARRANTY.** The Contractor shall warrant cable trays unconditionally against defects in workmanship for a period of one (1) year from the date of system acceptance. The warranty shall cover all labor and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. Replacement of faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.
- B. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- C. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.
- D. The Contractor shall provide a system warranty covering the installed cabling system against defects in workmanship, components, and performance, and covering follow-on support after project completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Drawings for specific requirements for sizes, and configurations. Minimum dimensions shall be 12 inches wide and 4 inches deep.
- C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
 - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.2 LADDER CABLE TRAYS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Mono Systems, Inc. or comparable product by one of the following:
 - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 2. Chalfant Manufacturing Company.
 - 3. Cooper B-Line, Inc.
 - 4. MP Husky.
 - 5. Niedax-Kleinhuis USA, Inc.
 - 6. US Tray; a United Structural Products Co.
- B. Description:
 - 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
 - 2. Rung Spacing: 6 inches on center over the entire length of the cable tray.
 - 3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 - 4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
 - 5. No portion of the rungs shall protrude below the bottom plane of side rails.
 - 6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
 - 7. Minimum Usable Load Depth: 4 inches.
 - 8. Width: 24 inches or as indicated on Drawings.
 - 9. Fitting Minimum Radius: 12 inches.
 - 10. The maximum uniform load and the support span are indicated by the cable tray class.
 - 11. Class Designation: Comply with NEMA VE 1, Class 12C.
 - 12. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - 13. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.
 - 14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.3 MATERIALS AND FINISHES

A. Aluminum:

1. Materials: Alloy 6063-T6 according to ANSI H 35.1/H 35.1M for extruded components and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H 35.1/H 35.1M for fabricated parts.
2. Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.4 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, radius drops, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 WARNING SIGNS

- A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel." Provide warning sign on 8' centers on both sides of cable tray.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA AND VE 2 Standards.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems."
- H. Place supports to provide clearances shown on Drawings.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze form as required by application.

- J. Locate and install supports at each end connection and at mid-span. Support interval shall not exceed 6 feet.
- K. Support trapeze hangers trays with 3/8-inch diameter rods.
- L. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- M. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- N. Make changes in direction and elevation using manufacturer's recommended fittings.
- O. Make cable tray connections using manufacturer's recommended fittings.
- P. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
- Q. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- R. Cable tray shall have 12" clearance above, 26" to one side, and 6" below. Cable trays shall be the first utility install above the ceiling.
- S. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to TIA/EIA 607 Standards unless additional grounding is specified. Comply with requirements in Section 270526 "Grounding and Bonding for Communications." Bonding conductor shall be a minimum of continuous #2 AWG copper.
- B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or

between cable tray and enclosure shall be no more than 72 inches. Factory radius drops shall be used for all transitions in elevation.

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Physically and electrically connect pathways to cable trays per specifications and drawings.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorquing in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. The maximum allowable resistance is 0.5 ohms.
- B. Prepare test and inspection reports.

3.6 PROTECTION

- A. Protect installed cable trays and cables.
 - 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
 - 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION – 270536

SECTION 270610 – VOICE AND DATA COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- B. The use of proprietary or copyrighted names or reference to patented trade items within this specification or elsewhere in the Contract Documents is meant to establish a standard of quality and performance. In no way does such use establish a restrictive competitive bidding situation, or exclude materials or equipment that is truly equivalent to the standard of quality. All materials and equipment proposed for installation must meet or exceed all specified requirements and be approved. Known equals are listed, but will require cut sheets with performance parameters to be submitted for final approval at least 10 days prior to bid.

1.2 SUMMARY

- A. Section Includes:
 - 1. Work Area Outlets
 - 2. 110 Copper Termination Block & Patch Panels
 - 3. Racks, Cabinets and Cable Management
 - 4. Horizontal Distribution Cable
 - 5. Backbone & DAS Cabling Cable
 - 6. Fiber Optic Termination Hardware
 - 7. Fiber Jumpers
 - 8. Pathways & Penetrations
 - 9. Audio Visual Infrastructure
 - 10. Power (UPS and PDU)
 - 11. Grounding and Bonding
 - 12. Copper Cable Protection Units
 - 13. Firestopping
 - 14. Cable System Identification System

1.3 SCOPE OF WORK

- A. The intent of this specification section is to cover the materials and installation of a structured cabling system and termination equipment as outlined herein and as detailed on the drawings. Work shall consist of:
- B. Work area outlets including faceplates, jacks (voice, data, CATV, A/V), and labels. Boxes and conduit are being provided by Div 26 contractor.
 - 1. Voice and data copper station cabling from work area outlets to telecommunications rooms including termination testing and labeling.
 - 2. Voice and data work area equipment cords.

3. Voice and data horizontal cross-connect jumpers and patch cables including labeling. This includes copper and fiber patch cables.
 - a. System Description -- Voice and Data station cabling (copper) system shall consist of:
4. Workstation outlet jacks.
5. Voice and data station cabling as specified herein from each workstation outlet to the termination equipment located in the Intermediate Distribution Frame (IDF).
6. Station Cable Termination Equipment in each MDF and IDF.
7. Final connections of the station cabling at the workstation outlet jack and the termination equipment in each MDF and IDF.
8. Cross connects / patch cable to connect work area outlets to backbone / network electronics.
9. Testing and labeling.

1.4 Regulatory References:

- A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the local Electrical Code and present manufacturing standards.
- B. All materials shall be UL or ETL Listed and shall be marked as such. If UL/ETL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL/ETL has an applicable system listing and label, the entire system shall be so labeled.
- C. All modular jacks, patch cords, consolidation point, and patch cords performance shall be verified (not just tested) by a third party to be category 6 component and channel compliant.
- D. The cabling system described in this is derived from the recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:
 - a. ANSI/TIA-568-C.0, Generic Communications Cabling for Customer Premises, February 2009
 - b. ANSI/TIA-568-C.1, Commercial Building Communications Cabling Standard Part 1: General Requirements, February 2009
 - c. ANSI/TIA-568-C.2, Balanced Twisted-Pair Communications Cabling and Components Standard, August 2009
 - d. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standards, June 2008

- e. ANSI/TIA-569-A, Commercial Building Standard for Communications Pathways and Spaces, February, 1998
 - f. ANSI/TIA-606-A, Administration Standard for Communications Infrastructure of Commercial Buildings, May, 2002
 - g. ANSI/J-STD-607-A, Commercial Building Grounding and Bonding Requirements for Communications, October, 2002
 - h. TIA-758-A, Customer-Owned Outside Plant Communications Cabling Standard, August 2004.
 - i. TIA-758-A, Customer-Owned Outside Plant Telecommunications Cabling Standard, August 2004.
 - j. ANSI/TIA-1179, Healthcare Facilities Telecommunications Infrastructure Standard
 - k. BICSI - TDMM, Building Industries Consulting Services International, Communications Distribution Methods Manual (TDMM) – 12th Edition.
 - l. National Fire Protection Agency (NFPA – 70)
 - m. FCC 47 CFR 68
 - n. NEMA 250
 - o. NEC 2014
 - p. ADA, Americans with Disabilities Act
- E. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
- F. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

1.5 Approved vendors

- A. The Installation Vendors (Contractors) must at a minimum possess the following qualifications:
1. Be in business a minimum of five (5) years
 2. Shall demonstrate satisfaction of sound financial condition and shall be adequately bonded and insured per owner's requirements.
 3. Possess those licenses/permits required to perform communications installations in the specified jurisdiction
 4. Personnel knowledgeable in local, state, province and national codes and regulations. All work shall comply with the latest revision of the codes and regulations. When conflict exists between local and national codes or regulations, the most stringent codes or regulations shall be followed.
 5. Must possess and provide proof of current owners insurance certificates
 6. Installers with RCDD on staff are preferred, at least one BICSI certified technician required.
 7. Must have prior experience with this type of installation or work activity. The customer may, with full cooperation of the contractor, visit client installations to observe equipment operations and consult with references. Specified visits and discussion shall be arranged through the contractors; however, the contractor's personnel shall not be present during discussions with references. The contractor must provide a minimum of three (3) references of similar jobs, one within the past 6 months and one at least 3 years ago where the same solution was installed.
 8. Documentation of ALL certifications to be provided in bid package
 9. Outside Plant Projects – will be done by pre approved vendor according to demographic and size of project

1.6 Work Included

- A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The Telecommunications contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
1. Furnish and install a complete telecommunications wiring infrastructure.
 2. Furnish, install, and terminate all UTP and Optical Fiber cable
 3. Furnish and install all wall plates, jacks, patch panels, and patch cords.
 4. Furnish and install all required cabinets and/or racks as required and as indicated.
 5. Furnish any other material required to form a complete system.
 6. Furnish and install cable tray where needed for the horizontal distribution.
 7. Furnish and install j-hooks where needed for the horizontal distribution.
 8. Furnish and install all materials to build out the IDFs as depicted on drawings
 9. Telecommunications contractor is responsible for the ladder rack in MDFs/IDFs. The basket tray for the horizontal distribution may be done by or in coordination with the electrical contractor
 10. Perform link testing (100% of horizontal and/or backbone links/channels) and certification of all components.
 11. Furnish test results of all cabling to the owner electronically, listed by each closet, then by workstation ID.
 12. Adhere and comply with all requirements of Manufacturer Certification.

13. Provide owner training and documentation. (Testing documentation and As-built drawings)

1.7 Submittals

- A. Under the provisions of this request for proposal, prior to the start of work the telecommunications contractor shall:
 1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this spec.
 2. Submit proof from manufacturer of contractor's good standing in manufacturer's program.
 3. No substitutions/alternatives from the manufacturers listed in this document will be permitted. No substituted materials shall be installed except by written approval.
 4. Product Data: For each type of product indicated.
- B. Submittals shall include manufacturer's data sheets (cut sheets) and be accompanied by a detailed bill of material, including part numbers and quantities.
 1. Shop Drawings:
 - a. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - b. Wiring diagrams to show typical wiring schematics including the following:
 - 1) Cross-connects.
 - 2) Patch panels.
 - 3) Patch cords.
 - c. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - d. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - 1) Vertical and horizontal offsets and transitions.
 - 2) Clearances for access above and to side of cable trays.
 - 3) Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - 4) Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 2. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
 3. Source quality-control reports.
 4. Field quality-control reports.
 5. Maintenance Data: For connectors to include in maintenance manuals.
 - a. Work shall not proceed without the Owner's approval of the submitted items.

1.8 Quality Assurance

- A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The contractor shall provide and install all of

the required material to form a complete system whether specifically addressed in the technical specifications or not. All installers must be employees of the contractor.

1.9 Delivery, Storage and Handling

- A. Cable shall be stored according to manufacturer's recommendations as a minimum. In addition, cable must be stored in a location protected from theft, vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F., the cable shall be moved to a heated (50 degrees F. minimum) location. If necessary, cable shall be stored off site at the contractor's expense.
- B. If the telecommunications contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner.

1.10 Drawings

- A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the telecommunications contractor in bidding the job. The telecommunications contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.
- B. The contractor shall verify all dimensions at the site and be responsible for their accuracy.
- C. Prior to submitting the bid, the telecommunications contractor shall call the attention of the Engineer to any materials or apparatus the telecommunications contractor believes to be inadequate and to any necessary items of work

1.11 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, Engineer, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces including any modifications to any existing equipment.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust arrangements and locations of racks, sleeves, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of utility demarcation, telephone and LAN equipment.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- C. ACTION SUBMITTALS
 - 1. Product Data: For each type of product indicated.
 - a. Submit Manufacturers technical data for each product, including related accessories. Furnish a material list with technical data documenting the location and primary function, quality and performance of each material component or system to be used in the work, or other such primary characteristics as required by the drawings or specifications.
 - b. Sustainable Design: LEED submittals conforming to requirements listed in section 013329.02 "Sustainable design reporting – LEED v 4.
 - c. Provide any of the following documentation: Greenscreen V1.2 benchmark, health product declaration (HPD), Environmental product Declaration (EPD), Pre-

- consumer and post-consumer recycled content, FSC certified wood, or other documentation as defined in “Sustainable design reporting” – LEED v4.
- d. Failure to provide above documentation will disqualify products where this documentation is required for LEED compliance. Reference “Sustainable Design reporting – LEED v4.
- e. Indoor Environmental quality Credits:
- f. Product Data for wet-applied products, indicate VOC content, emissions and volume.
- g. Laboratory test reports: For applicable building materials, indicate compliance with requirements for low-emitting materials
- h. Where applicable, provide formaldehyde-free documentation.
- i. Sustainable Design:
- j. LEED submittals conforming to requirements listed in section 013329.02 “Sustainable design reporting – LEED v4”
- k. Provide any of the following documentation: NSF61 and NSF 372 Certification, or other documentation as defined in “sustainable design reporting.

PART 2 – PRODUCTS

2.1 Equivalent products

- A. Due to the nature and type of communications all products and solutions in this document have a standard of quality listed. Substitutions are listed, but products MUST demonstrate performance equivalency.

2.2 Work Area Outlets

- A. Work area cables shall each be terminated at their designated work area location in the connector types described in the subsections below. Included are modular telecommunication jacks. These connector assemblies shall snap into a faceplate.
- B. The Telecommunications Outlet Assembly shall accommodate:
 - 1. A minimum of two (2) modular jacks unless specified. Additional copper cables as necessary.
 - 2. A blank filler will be installed when extra ports are not used.
 - 3. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.
 - 4. The modular jack shall incorporate printed label strip on the dust cap module for identifying the outlet. Printed labels shall be permanent and compliant with ANSI/TIA–606-A standard specifications. Hand printed labels shall not be accepted.
- C. Faceplates: Standard of quality is Ortronics Part # OR-403HDJ14
 - 1. The faceplates shall:
 - a. Be of the style as appropriate to fit the modular jack used
 - b. Have mounting screws located under recessed designation windows.
 - c. Comply with ANSI/TIA 606-A work area labeling standard.
 - d. Workstation Outlets: Connector assemblies mounted in faceplate. Provide number of ports as shown on the Drawings.
 - e. Retain one of first two subparagraphs below, or retain both as required to match Division 26 Section "Wiring Devices."
 - f. Plastic Faceplate: High-impact plastic.

- g. For use with snap-in jacks accommodating any combination of UTP, F/UTP, optical fiber, and coaxial work area cords.
 - h. Acceptable substitutions are TE Connectivity, Systimax, Leviton and Panduit
- D. Voice / Data Jacks: Standard of quality is Ortronics
- 1. Jacks: 100-ohm, unshielded balanced, twisted-pair connector; four-pair, eight-position modular. Comply with ANSI/TIA-568-C.2 up to 500 MHz.
 - 2. Jacks shall match cable color.
 - 3. All pair combinations must be considered, with the worst-case measurement being the basis for compliance. Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory.
 - 4. The modular jack shall be backwards compatible to Category 3, 5, and 5e.
 - 5. The modular jack shall be center tuned to category 6 test specifications. Where indicated, the modular jacks shall be category 6A.
 - 6. Cat 6A jacks to be used for all Wireless Access Points.
 - 7. Acceptable substitutions are TE Connectivity, Systimax, Belkin, Leviton and Panduit
 - 8. Manufacture must meet requirements of PART 4 – WARRANTY AND SERVICES for the entire system, not just the cabling portion.

Part Number	Description
OR-HDJ6-36	Ortronics Category 6 T568A/B High Density (HD) Jack Blue (Data)
OR-HDJ6A-36	Ortronics Category 6A T568A/B High Density (HD) Jack Blue (Data)
OR-HDJ6-44	Ortronics Category 6 T568A/B High Density (HD) Jack Yellow (Voice)
OR-HDJ6-43	Ortronics Category 6 568A/B High Density (HD) Jack Orange (Where Indicated on plans)
OR-HDJ6-##	Refer to systems plans for breakdown of systems by color.

2.3 110 Copper Termination Block

- A. The voice cross connect shall be a passive connection between the horizontal termination blocks and the backbone termination blocks. The wall mount frames shall be field terminated kits including all blocks, connecting blocks, and designation strips.

- B. Management rings shall be mounted between vertical columns of blocks to provide management of cross-connect wire.
- C. Backbone and horizontal blocks shall use 4-pair connecting blocks. Blocks shall be oriented so that backbone terminations are located on the left and horizontal frames are located on the right of the termination field when facing the frame assembly.
- D. Standard of quality: Ortronics
- E. 110 Block Kits shall:
 - 1. Include both the wiring block in a 50, 100 and 300 pair footprint and the connecting block C6110C5
 - 2. Be manufactured using fire retardant molded plastic.
 - 3. Support termination of 22-24 AWG solid conductor
 - 4. Wiring block shall contain back openings for the feed through of cable
 - 5. Have color-coded tips on the wiring block and color coding on the connector blocks for installation identification.
 - 6. Shall use standard termination practice requiring a single conductor 110 impact tool
 - 7. Have termination hardware that maintains the paired construction of the cable to facilitate minimum untwisting of the wires.
 - 8. Be backwards compatible to category 3, 5, and 5e
- F. 110 Cross-Connect System Backboard Channels Shall
 - 1. Be available in 300 and 900 pair sizes.
 - 2. Allow the mounting of 110 100-pair blocks without legs.
 - 3. Include bottom trough and grounding bar.
 - 4. Be wall mountable.
 - 5. Be of cold roll steel construction.
- G. 110 Wall Mount Vertical Trough Shall
 - 1. Be available in single channel or dual channel configurations.
 - 2. In dual channel configuration shall be used to provide separation for different wiring media.
 - 3. Be available in 300 pair and 900 pair sizes.
 - 4. Be wall mountable.
 - 5. Be used with wall mountable backboard channels. Acceptable configurations include a 300 pair and a 900 pair.
 - 6. Be of cold roll steel construction.

Note: Project may require horizontal analog and backbone cables to be terminated on patch panels in IDF/MDF's. Contact Telecom Representative for details.

2.4 Modular Patch Panels

- A. The Modular Patch Panels shall
 - 1. Meet category 6 component compliance and be verified by a third-party nationally recognized independent testing laboratory
 - 2. Be backward compatible to category 3, 5, and 5e
 - 3. Be center tuned to category 6 or category 6A test specifications – refer to plan details.
 - 4. Standard of Quality is Ortronics

Part Number	Description
OR-PSAHJU48	48 Port unloaded 2RU Angled Panel (for HD Jacks)

1. Acceptable Substitutions are TE Connectivity, Systimax, Leviton and Panduit

2.5 Racks, Cabinets, and Cable Management

A. The equipment rack shall provide vertical cable management and support for the patch cords at the front and back of the rack. Waterfall cable management shall be provided at the top of the rack to maintain proper bend radius and cable support. Wire management shall also be mounted above each patch panel and/or piece of equipment on the rack. The rack shall include mounting brackets for cable tray ladder rack to mount to the top of the rack.

B. Free-Standing Rack shall:

1. Provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA 568-B.
2. Have ANSI/TIA hole pattern on front and rear.
3. Provide pre-drilled base for floor attachment of rack.
4. Be available in standard color of black or white.
5. Standard of quality for 2 and 4 post racks shall be Ortronics.

Part Number	Description
OR-19-84-T2SDB	Standard black TIA 2 Post Rack, 7' high with 3" channel depth
OR-MM107SVR	Standard black TIA 4 Post Rack, 7' high with 3" channel

	depth

6. Acceptable substitutions are Tripp Lite and Panduit

C. The vertical cable management shall be utilized and installed with the 2 and 4 post racks.

1. They shall include snap on covers/doors that can swing either direction.

2. Standard of quality for vertical cable management shall be Ortronics.

Part Number	Description
OR-DVMS706	Double Sided 6" Vertical Cable Management with door, 6" W x 6.58" D x 7' H (for end of row or single racks)
OR-DVMS710	Double Sided Vertical Cable Management with door, 10" W x 13.15" D x 7' H (for between racks)

3. Acceptable substitutions are Tripp Lite and Panduit

D. Wall Mounted Cabinet shall:

1. Provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA 568-C.

2. Have wall mount braces with locator posts for easy wall mounting.

3. Have side access points that allow for access to manage/install distribution cables in the vertical channels.

4. Be lockable.

5. Contain integrated vertical cable management

6. The standard of quality for wall mount cabinet shall be Ortronics:

Part Number	Description
OR-MMW122426P-B	24"W x 26"D x 23.5"H, plexi-glass door 12 RU; 150 lbs*
OR-MMW262426P-B	24"W x 26"D x 48"H, plexi-glass door 26 RU; 300 lbs*

*weight capacity

7. Acceptable substitutions are Tripp Lite and Panduit

2.6 Horizontal Distribution Cable

A. All horizontal data station cable and voice cable shall terminate on modular patch panels (copper), or patch/splice cabinets (fiber) in their respective MDF or IDF as specified on the drawings.

B. Copper or fiber cable that offers EPDs (Environmental Product Declaration) and / or HPDs (Health Product Declaration) to apply toward LEED certification are PREFERRED.

1. Products covered by EPDs and HPDs contribute towards one (1) point each in the Material and Resources credit (MRc) category for projects pursuing those credits

2. Products that have both EPDs and HPDs will effectively contribute towards two (2) separate credits in the MR category

C. 100 OHM Category 6 UTP with fire-resistant thermoplastic jacket with separator or divider between pairs.

1. Physical Characteristics:

- a. Plenum (only plenum rated cable for this project)
 - 1) Insulation FEP
 - 2) Jacket: FR, low smoke PVC
 - 3) Nominal Velocity of Propagation: 73
- b. Solid annealed copper conductors
- c. 23 AWG copper conductors
- d. Low-dielectric thermoplastic insulation
- e. Pair-separator for improved performance
- f. Characteristic Impedance: 100 ± 15 Ohms
- g. Comply with UL 444
- h. Comply with NFPA 262
- i. Comply with ICEA S-90-661 for mechanical properties.
- j. Comply with ANSI/TIA-568-C.2 for Category 6 UTP cables.
- k. Verified for Category 6 performance by an NRTL
- l. Must contain less than 300 ppm lead content.
- 2. Performance Characteristics:
 - a. Guaranteed electrical performance up to 400 MHz
 - b. Guaranteed 3 dB margin over ANSI/TIA-568-C.2 requirements for NEXT and PSNEXT

- c. Guaranteed 4 dB margin over ANSI/TIA-568-C.2 calculated requirements for ACR and PSACR
 - d. Printed with unique alpha-numeric code for each package of product
 - e. Printed in both feet and meters with the units of length decrementing to indicate the amount of cable remaining in the box.
 - f. Tip colors shall be a lighter version of the ring color.
 - g. 4 pair UTP for Wireless Access Points for speeds in excess of 1 Gigabit transmission (A/C):
Cat 6 with isolation wrap (no ground required) or actual shield (needs grounding).
3. Design Make:
- a. Standard of quality is Superior Essex DATAGAIN Cat 6+ UTP.

Plenum Part Number	Description
66-240-2B	Data / Blue / CMP Cat6
66-240-6B	Voice / Yellow CMP Cat6
66-240-DB	Video / Orange / CMP Cat6

- b. Acceptable Substitutions are TE Connectivity, Systimax, General Cable and Panduit
- c. Standard of quality for Cat 6A Superior Essex 10GainXP Plenum (CMP) UTP w/ isolation wrap.

Plenum Part Number	Description

6H-272-2B	Wireless / Blue / CMP

d. Acceptable Substitutions are TE Connectivity (shielded), General Cable (shielded), Panduit (Isolation Wrap) and Systimax (shielded)

2.7 Backbone Cable

A. Intrabuilding multipair unshielded twisted pair

1. General purpose 25 pair plenum Cat 5e (Superior Essex cmp part #51-478-48)

2. For higher pair counts when Cat 3 is acceptable; 100 pair category 3 plenum unshielded twisted pair (Superior Essex Category 3 cmp part number 18-799-36) may be used.

B. Fiber Optic Cables

1. Multimode: Armored Optical Fiber Plenum (OFCP) Tight Buffered With 10 Gigabit OM4 Laser Optimized 50/125 Optical Fibers

a. Each Multimode Fiber shall be:

1) Graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.

2) The fiber shall comply with the latest revision of ANSI/TIA-492AAAC.

3) Attenuation shall be measured in accordance with ANSI/TIA-455-78.

4) Information transmission capacity shall be measured in accordance with ANSI/TIA-455-204 or -455-220.

- 5) The measurements shall be performed at $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$.
- 6) Maximum attenuation dB/km @ 850/1300 nm: 2.3/0.6
- 7) Bandwidth: 3500 MHz-km @ 850nm for overfilled launch,
- 8) Bandwidth 500 MHz-km @ 1300nm.
- 9) Optical Fiber shall be laser optimized and guaranteed for 40/100 Gigabit Ethernet distances of 100 meters
- 10) Optical Fiber shall be laser optimized and guaranteed for 10 Gigabit Ethernet distances of 550m/550m for 850nm and 1300nm respectively
- 11) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 1000m/600m for 850nm and 1300nm respectively

b. Physical Characteristics:

- 1) Shall be suitable for use in indoor applications.
- 2) Shall be suitable for use in risers, plenums and horizontal applications.
- 3) Shall be available with a fiber strand count range from 6 to 144.
- 4) Shall meet NFPA 626
- 5) Shall comply with Telcordia GR-409.
- 6) Shall comply with the requirements of ICEA S-83-596.
- 7) Buffered fibers shall be color coded in accordance with TIA-598 with an overall aqua jacket.
- 8) Shall have a central strength member
- 9) Suitable for operation between -20°C to $+75^{\circ}\text{C}$

- 10) Shall meet UL 1569, UL 1651
- 11) Must contain less than 300 ppm lead content.
- 12) Shall have spiral wrapped aluminum armor and outer jacket

c. Design Make:

- 1) Standard of quality for Premise Distribution optical fiber cable with OM4 laser optimized 50/125 micron multi mode fiber is Superior Essex, part numbers below

Part Number	Description
L4012P401	6 strand armored laser optimized 50 micron multi mode
L4012N401	12 strand armored laser optimized 50 micron multi mode

- 2) Acceptable Substitutions are TE Connectivity, Systimax and Corning

2.8 Fiber optic termination hardware

A. FIBER OPTIC ENCLOSURES

- 1. Fiber optic termination hardware is rack mountable, lockable, and holds various coupler panels based on density requirements.

2. Fusion Splicing shall be the preferred termination style for any new installations, but mechanical terminations may be used as well.
3. Standard of quality is Ortronics
4. Acceptable Substitutions are TE Connectivity, Systimax, Leviton, Panduit and Corning
5. Fiber Enclosures

Part Number	Description
OR-FC01U-C	1U combo splice/patch enclosure, holds 3 adapter panels,
OR-FC02U-C	2U combo splice/patch enclosure, holds 6 adapter panels,
OR-FC04U-C	4U combo splice/patch enclosure, holds 12 adapter panels,

- i. Splice trays for combo panels sold separately

Part Number	Description
OR-FST2-F012	Fusion Splice Tray for 12 splices
OR-20500043	Splice Sleeves for 12 strand tray 40mm x 3.0mm 50 pack

Fan Out Kits

Part Number	Description
OR-61500868	Breakout Kit 12 fiber

B. FIBER OPTIC ADAPTER PANELS

ii. Ortronics Adapter panels will be of 6 duplex SC connectors (12 fibers) for multimode connections.

Part Number	Description
OR-OFP-SCD12LC	6-SC Duplex multimode, aqua adapters, ceramic sleeve
OR-OFP-SCD12AC	6-SC Duplex Single mode, blue adapters, ceramic sleeve
OR-OFP-BLANK	Blank Filler modules

C. FIBER OPTIC PIGTAILS / CONNECTORS

iii. For fiber splicing, utilize Ortronics 12 strand SC fiber pigtails Ortronics part numbers:

- a. Single Mode OR-P1TC4ZRRZZZ001M
- b. Multi Mode OR-P1TF4ZRFZZZ001M

iv. When mechanical terminations are acceptable for MAC work, Utilize Ortronics SC multimode (OR-205KNT9FA-50T) Infinium Connectors for standard terminations.

Part Number	Description
OR-P1TF4ZRFZZZ001M	12 strand Multimode SC fusion splice pigtail

v. Acceptable Substitutions are TE Connectivity, Systimax and Corning

2.9 Patch Cords & Fiber Jumpers

- A. The contractor shall provide factory terminated and tested optical fiber patch cords for the complete cabling system.
- B. Fiber jumper cords shall:

1. Standard of quality for Multimode duplex 5 meter 50 um 10 gig aqua for multimode applications is Ortronics SC to SC (OR-P1DF2LRGZGZ005M).
2. Provide four (4) duplex SC-SC 5 meter jumpers per switch in each TR.
3. Standard of quality for Single Mode duplex 5 meter for single mode applications is Ortronics SC to SC (OR-P1DC2IRSZSZ005M).
4. Provide two (2) duplex SC-SC 5 meter jumpers per rack in each TR.
5. Acceptable substitutions are Quiktron, TE Connectivity, Systimax and Corning

2.10 Copper Cable Protection Units

- A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a minimum #6 AWG copper bonding conductor between the protector ground lug and the TC ground point.
- B. Standard of quality of protection units is Circa.
- C. The two most frequently used lightning protectors are listed below.
- D. Circa Protector -- "Circa", part number 1900A1-100, and Circa 3B3S-300 "Red" modules -100 for 100 pair.
- E. Use Circa ,part number 1880ENA1/NSC-6 for single drops of 6-pair or less. Use Circa, part number 3B1E gas protector modules.

Part Number / Series	Description
1890BC1-25	25 Pair Protector
1890BC1-50	50 Pair Protector
1900A1-100K	100 Pair Protector
3B1E	Solid State Protector Module for 189B1
2626QC/QC	Protection Block (66 connection must add gas modules 3B1E (black) or 3B3E (red))
4B1E	Gas state Protector 5 Pin Black with Heat Coil
4B3S-75	Protector Module 5 Pin Red Solid state with Heat Coil

3B3S-300	Protector module 5 Pin Red Solid state w/o Heat coil
4B1S-300	Protector Module 5 Pin Black Solid state with Heat Coil
1880ENA1/NSC-6	6 Pair Protector

2.11 Grounding and Bonding

- A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA-607 Telecommunications Bonding and Grounding Standard.
- B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding bus bar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bus bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.
- D. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this specification.
- E. Standard of quality for all grounding and bonding products shall be Ortronics.
- F. Acceptable substitutions are Erico and Panduit

PART 3 – EXECUTION

3.1 Work Area Outlets

- A. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. In hollow wall installations where Caddy box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP and 36" of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- B. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA 568-C.1 document, manufacturer's recommendations and best industry practices.
- C. Pair untwist at the termination shall not exceed 12 mm (one-half inch).

- D. Bend radius of the twisted-pair horizontal cable shall not be less than 4 times the outside diameter of the cable.
- E. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.
- F. Data jacks, unless otherwise noted in drawings, shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).
- G. Voice jacks shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

3.2 Horizontal Distribution Cable Installation

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the ANSI/TIA 569-B maximum fill for the particular raceway type or 40%. Minimum conduit size for data cabling is 1".
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- E. Where transition points, or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- G. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- H. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- I. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- J. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
- K. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
- L. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA 606-A. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- M. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
- N. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

3.3 Horizontal Cross connect Installation

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA 568-C standard, manufacturer's recommendations and best industry practices.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

- D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. The cable jacket shall be maintained as close as possible to the termination point.
- F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.4 Optical fiber termination hardware

- A. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.
- B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.
- C. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- D. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
- E. A maximum of 12 strands of fiber shall be spliced in each tray
- F. All spare strands shall be installed into spare splice trays.

3.5 Backbone Cable Installation

- A. Backbone cables shall be installed separately from horizontal distribution cables
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits
- D. Where backbone cables are installed in an air return plenum, riser rated cable shall be installed in metallic conduit.
- E. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- F. All backbone cables shall be securely fastened to the sidewall of the TR on each floor.
- G. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
- H. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
- I. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

3.6 Copper Termination Hardware

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA-568-C standard, manufacturer's recommendations and best industry practice.
- B. Pair untwist at the termination shall not exceed 12 mm (one-half inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

- D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.
- F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.7 Racks

- A. Racks shall be securely attached to the concrete floor using a minimum 3/8" hardware or as required by local codes.
- B. Racks shall be placed with a minimum of 36 inch clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.
- C. All racks shall be grounded to the telecommunications ground bus bar in accordance with Section 2.11 of this document.
- D. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
- E. Wall mounted termination block fields shall be mounted on 4' x 8' x .75" void free plywood. The plywood shall be mounted vertically 12" above the finished floor. The plywood shall be painted with two coats of white fire retardant paint.
- F. Wall mounted termination block fields shall be installed with the lowest edge of the mounting frame 18" from the finished floor.

3.8 Firestop System

- A. All firestop systems shall be installed in accordance with the manufacturer recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance. Refer to plans for more details on firestopping.

3.9 Grounding System

- A. The TBB shall be designed and/or approved by a qualified PE, licensed in the state that the work is to be performed. The TBB shall adhere to the recommendations of the ANSI/TIA 607-A standard, and shall be installed in accordance with best industry practice.
- B. Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by a licensed electrical contractor.

3.10 Identification and Labeling

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At

a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. Labeling shall follow the guidelines of ANSI/TIA-606-A.

- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of ANSI/TIA-606-B. Furnish electronic record of all drawings, in software and format selected by Owner.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - 4. Both ends of all backbone cable shall be labeled. Labels will be self laminating and machine generated. The label shall contain the following information:
 - a. The Origination (TR it is feeding from).
 - b. The Destination (TR it is feeding).

c. Number of pairs or fibers

5. Both ends of all horizontal cables shall be labeled. Labels shall be self-laminating and machine generated. The cable, workstation faceplate, panel ports and block positions shall be labeled with the room number, location in room, outlet type & # (data D1, D2, etc). In rooms with multiple outlets, label clockwise as you enter the room: 1, 2, 3 e.g. a data port at the first drop location to the left of Room 216 door would be (216-1 D1). When terminating workstation cables in the TR, organize and label the cables in numeric room number order at the patch panel.

6. CNS will approve all labeling schematics prior to installation. "As-Built" drawing with all outlets identified shall be provided.

F. Labels shall be self-laminating or computer-printed type with printing area and font color that contrasts with cable jacket color. Handwritten labels will not be acceptable.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

2. All labeling methodology, identification logic, and materials will be approved by customer prior to installation.

3. If existing labeling scheme is in place, all labeling will defer to current scheme as to stay consistent with facility.

3.11 Testing and Acceptance

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA 568-C; marginal passes (*PASS) are not acceptable. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

2. All cables shall be tested in accordance with this document, the ANSI/TIA standards, the Ortronics Certification Program Information Manual and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance.
2. Horizontal cabling shall be tested using a Level III test unit for category 6 performance compliance.
3. The basic tests required are:

Wire Map

Length

Attenuation

NEXT (Near end crosstalk)

Return Loss

ELFEXT Loss

Propagation Delay

Delay skew

PSNEXT (Power sum near-end crosstalk loss)

PSELFEXT (Power sum equal level far-end crosstalk loss)

4. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

5. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA 568-C Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

6. Category 6 Performance

Shall meet the channel requirements outlined below for a 100-meter, 4-connector channel.

Channel Margin Guarantees

Parameter	Margin vs. TIA-568-C.2
Insertion Loss	3%
NEXT	5 dB
PSNEXT	5 dB
Return Loss	3 dB
ACRF	5 dB
PSACRF	5 dB
ACR	5 dB
PSACR	5 dB

C. Fiber Testing

1. Testing procedures shall be in accordance with the following:

- vi. ANSI/TIA 568-B
- vii. ANSI/TIA 568-B.1
- viii. ANSI/TIA 526-7, Method A.1
- ix. ANSI/TIA 526-14A, Method B
- x. TSB-140 Tier 1 fiber testing is required. Tier 2 Fiber Testing is recommended

2. Preparation

- xi. Properly clean all connectors, adapters, and jumpers prior to testing.
- xii. Insure that the testing jumpers are of the same fiber core diameter and connector type as the fibers to be tested.
- xiii. The power meter shall be properly calibrated prior to testing. Contractor to provide written confirmation of the calibration, with the power meter serial number, to the Owner, if requested. If this documentation is not available upon request, the Contractor shall re-test all optical fiber cables after documented calibration of the power meter is accomplished.

3. Test Equipment

- xiv. Optical power meter and source (Certification tester Fluke or Agilent preferred). Suitable OTDR with launch cable for Tier 2 testing. OTDR Launch Cable length recommendation is 75 meters for MMF and 300 meters for SMF systems.

4. Testing

- xv. All Multimode fibers shall be tested to the requirements of ANSI/ TIA-568-B, TIA-525-14A (Method A.1) and TSB-140. Optical fibers shall be tested at both 850 nm and 1300 nm wavelengths for end-to-end insertion loss .and Bi –Directional (MTR to TR-1, TR-1 to MTR)
- xvi. All Single-mode fibers shall be tested to the requirements of ANSI/ TIA-568-B, TIA-526-7 (or Method A.1) and TSB-140. Optical fibers shall be tested at both 1310 nm and 1550 nm wavelengths for end-to-end insertion loss and Bi-Directional (MTR to TR-1, TR-1 to MTR)
- xvii. Insure that the power meter and light source are set to the same wavelength prior to testing each fiber.
- xviii. Connect an appropriate test jumper to the light source and power meter.
- xix. Power on both the power source and light meter, allowing them to stabilize.
- xx. Record the reference power reading in dB. If the jumper is removed from the light source for any reason, the reference power reading must be re-established.
- xxi. Insert a second appropriate jumper, using an appropriate adapter, between the first jumper and the power meter. Record the power reading in dB.
- xxii. Reference TSB-140 for additional recommendations and testing guidelines.
- xxiii. Provide written documentation of all test results to owner. Provide electronic copy of test results, in original tester format, to manufacturer when registering project for warranty on-line.

3.12 System Documentation

- A. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to the Engineer for approval. Documentation shall include the items detailed in the sub-sections below.
- B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test result and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the request of the Engineer, the telecommunications contractor shall provide copies of the original test results.
- C. The Engineer may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.13 Test Results

- A. Test documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
- B. The field test equipment shall meet the requirements of ANSI/TIA 568-C including applicable TSB's and amendments. The appropriate Level III tester shall be used to verify Category 6 cabling systems.
- C. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The telecommunications contractor must furnish this information in electronic form (CD-ROM).
- D. Test documentation shall also be provided to the manufacturer within three weeks after the completion of the project. Test results shall be uploaded when registering the project for warranty using the manufacturer's on-line system. Test results shall be in the tester's original format from an approved tester listed on manufacturer's website. All test results must show a PASS; marginal passes (*PASS) are not accepted.
- E. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

3.14 As-Built Drawings

- A. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in

paper and electronic (DWG, AutoCAD rel. 14) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.

- B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD rel. 14) form.

PART 4 – WARRANTY AND SERVICES

4.1 Warranty

- A. A warranty shall be provided for all internal infrastructure wiring as it pertains to voice and data networking for both copper and fiber systems. All installations must be performed according to the manufacturer's System Warranty and Performance Application.
- B. The warranty will combine an extended product and applications assurance warranty for a minimum of 25 years.
- C. An Extended Product Warranty shall be provided which warrants functionality of all components used in the system from the date of registration. The Extended Product Warranty shall warrant the installed horizontal and/or backbone copper, and both the horizontal and the backbone optical fiber portions of the cabling system.
- D. The Application Assurance Warranty shall cover the failure of the wiring system to support the applications that are designed for the link/channel specifications of ANSI/TIA-568-B.1. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.
- E. The contractor shall provide a warranty on the physical installation.

4.2 Continuing maintenance

- A. The contractor shall furnish an hourly rate with the proposal submittal, which shall be valid for a period of one year from the date of acceptance. This rate will be used when cabling support is required to affect moves, adds, and changes to the system (MACs). MACs shall be performed by a certified Contractor and shall be added to the warranty when registered with manufacturer.

4.3 Final Acceptance & System Certification

- A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a two week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, the end user shall be provided with a certificate, from the manufacturer, registering the installation.

END OF SECTION – 270610

SECTION 274100 – AUDIO VIDEO SYSTEMS

PART 1- GENERAL

1.1 Related Requirements

- A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions, Division 01 Specification Sections, and Division 27 Specification Sections apply to this section of work.
- B. The intent of these specifications and the accompanying contract drawings is to provide complete and workable systems as shown, specified and required by applicable codes. Interpret these specifications in conjunction with the drawings and provide all work described. If work is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both. Should there be a conflict between the specifications and drawings, provide the greater quantity or better quality. Immediately notify owner's representative and design professional of such conflicts.
- C. Coordinate all new work with all other contractors and installers in addition to existing building obstructions and install accordingly. Refer to coordination drawings of other trades. Comply with requirements of architectural drawings including but not limited to mounting height and locations.
- D. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 General Overview

- A. The Owner is seeking Audio Video (AV) systems installation work within classrooms, labs, conference rooms, common areas and other meeting spaces for their new and renovation projects. This document along with floorplan and other drawings shall be referenced for the system types described herein for the creation of a contractor proposal.

1.3 System Description

- A. The following are descriptions of system types found within this project. Refer to floorplans to determine types and quantities of each required system. See the Products for basis of design equipment and alternates, and the System Diagrams

included with the drawing package for list of major equipment to be provided for each system type.

- B. Standard Classroom – This space shall include one (1) wall mounted flat panel display. It shall include an owner supplied podium with inputs for laptop, owner supplied desktop computer and device for wireless interfacing (BYOD) with the display. The devices within the room shall be controlled by an AV control processor and button panel screen. The space shall also feature overhead speakers and amplification for audio content.
- C. Simulation Lab – AV technology provided by owner’s simulation integrator (CAE).
- D. Simulation Lab Debriefing Room - This space shall include a smaller wall mounted flat panel display with HDMI input.
- E. Clinical Learning Lab – This space shall include one (1) cart mounted createboard with HDMI input. The cart shall also feature one (1) cart mounted sound bar for audio content.
- F. Conference Room - This space shall include one (1) large wall mounted flat panel display along with ceiling mounted beam forming microphones. It shall include a wall mounted PTZ camera along with overheard speakers for audio reinforcement. It shall include inputs for a laptop source as well as a wireless interface for BYOD. The space shall interface with the Zoom client on the owner provided desktop computer. Devices within the room shall be controlled by an AV control processor and touch screen.
- G. Huddle Room - This space shall include a smaller wall mounted flat panel display and a wall mounted soundbar with integrated microphones along with a USB camera connected to a small form factor owner provided PC running Zoom client software.
- H. Digital Signage – Locations designated for digital signage shall include a wall mounted flat panel display and network connect digital signage player.
- I. Room Scheduling Panels – Conference and Huddle rooms with AV shall have a room scheduling panel. Coordinate the required mounting hardware with the location in which it is depicted i.e., if the panel must be installed on glass or a mullion provide the necessary mounting hardware for this location.

1.4 Permits And Regulations

- A. Provide work in compliance with applicable provisions of the following standards. Provide products, marked for respective intended uses, from UL or

other Nationally Recognized Testing Laboratory (NRTL) that is acceptable to applicable Authorities Having Jurisdiction (AHJs).

- B. Provide materials, installation methods, workmanship, testing, etc., in strict accordance with the latest edition of applicable standards and adopted codes, including (but not limited to) the following:
 - 1. International Building Code
 - 2. State Building Code and applicable amendments
 - 3. All provisions and requirements of NFPA (National Fire Protection Association)
 - 4. National Electrical Code (NEC), NFPA 70
 - 5. Local governmental and other prevailing codes and ordinances
 - 6. ADA/ADAAG requirements (American with Disabilities Act) including all applicable Standards for Accessible Design.
- C. Obtain and pay for permits, fees, certificates of inspection and approval, etc. required for this branch of the work. Furnish Owner with certificates of final inspection and approval prior to final acceptance of this branch of the work.

1.5 References

A. Definitions

- 1. Furnish - Procure, supply and deliver to project site, ready for installation, install and warrant (unless indicated otherwise on documents). Include warranty expenses.
- 2. Install - Assemble, wire and connect loose-shipped components on site. Place in position for service or use, including material, labor, accessories, services, and testing. Wire, connect, and render fully operational for intended use.
- 3. Provide - Furnish and Install. Similar Terms: "include", "shall", "equip with", "consisting of"
- 4. Equal or Equivalent - Determination of equivalency to be made by owner and design professional for all products not listed as basis-of-design.
- 5. Substantial Completion - Products and systems are fully installed as designed, tested, adjusted, labeled, functionally demonstrated, and training provided to the owner.
- 6. Audio Video (AV) Systems Work: That portion of the Project that involves the supply, installation, programming, or testing of products whose fundamental purpose is the reproduction, pickup, storage, transporting, processing, control of audio and/or video signals. Scope of this definition includes all incidentals that are regularly and

fundamentally required to provide complete and working systems from the small and simple to the large and complex.

1.6 Warranty

- A. Provide a warranty/guarantee in written form as part of O&M manual stating that all work, materials, software / programming, equipment and parts are warranted to be operational and free of defect for a minimum period of one (1) year from the date of Substantial Completion. Repair or replace (owner's option) any defects or failures at no cost to the owner within the warranty period. Issues arising within warranty period must be attended to in a timely manner and in no case exceed two (2) working days. State this in writing as part of O&M manual.

1.7 Quality Assurance

- A. Qualifications:
 - 1. Business history of the last five (5) contiguous years performing work of similar type, value and scope as that required of the Contract Documents.
 - 2. Capable of demonstrating through valid references upon request, that it has successfully completed no less than six (6) projects of similar type, monetary size, and scope of work within the last twenty-four (24) calendar months.
 - 3. A "Factory-authorized" reseller (e.g., distributor, dealer, integration partner, value-added reseller, channel partner) for the products furnished for each Section.
 - 4. Financial Disclosure of the Contractor: Prior to contract award, upon owner request.

1.8 Submittals

- A. Submittals shall be routed through established Project channels as identified by the Owner's representative.
- B. Required Submittals for this section:
 - 1. Product Data Submittals
 - a. Bill of Materials (BOM):
 - i. When a Section covers products for use in multiple systems, supply separate BOM for each unique system covered by the Section. Label each with the system name, space/room name, and room number. Include the following: Make, model, and description of each product. Quantity estimates for each product.
 - b. Product Data Sheets:
 - i. Separate manufacturer datasheets for each product. Where manufacturer's datasheets depict multiple products, versions and options, indicate via highlighting,

underlining, or with bold visible arrows the model(s), version(s) and option(s) being supplied.

- c. Shop Drawings:
 - i. Scaled floor plans indicating place and quantity of devices being supplied.
 - ii. System Diagrams indicating schematic block wiring diagrams with product inputs, outputs and cabling types depicted.
 - iii. Rack Elevations where applicable.
 - iv. Mounting elevations for AV devices.
- d. Closeout Submittals:
 - i. BOM and Product Data for each product supplied.
 - ii. As-built drawings including updated versions of the above required shop drawings.
 - iii. Operation and Maintenance manuals for all supplied equipment.
 - iv. Warranty statement as described above.
 - v. Training information including outlines, handouts, cheat sheets and video recordings.
 - vi. Programmable-product configuration file(s). Source code version of files necessary for changes to be made by qualified personnel.

1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Submit Manufacturers technical data for each product, including related accessories. Furnish a material list with technical data documenting the location and primary function, quality and performance of each material component or system to be used in the work, or other such primary characteristics as required by the drawings or specifications.
 - 2. Sustainable Design: LEED submittals conforming to requirements listed in section 013329.02 “Sustainable design reporting – LEED v 4.”
 - a. Provide any of the following documentation: Greenscreen V1.2 benchmark, health product declaration (HPD), Environmental product Declaration (EPD), Pre-consumer and post-consumer recycled content, FSC certified wood, or other documentation as defined in “Sustainable design reporting” – LEED v4.
 - b. Failure to provide above documentation will disqualify products where this documentation is required for LEED compliance. Reference “Sustainable Design reporting – LEED v4.
 - c. Indoor Environmental quality Credits:
 - i. Product Data for wet-applied products, indicate VOC content, emissions and volume.

- ii. Laboratory test reports: For applicable building materials, indicate compliance with requirements for low-emitting materials
 - iii. Where applicable, provide formaldehyde-free documentation.
- d. Sustainable Design:
 - i. LEED submittals conforming to requirements listed in section 013329.02 "Sustainable design reporting – LEED v4"
 - 1) Provide any of the following documentation: NSF61 and NSF 372 Certification, or other documentation as defined in "sustainable design reporting.
 - ii.

PART 2 - PRODUCTS

2.1 General Product Requirements

- A. Products furnished shall be new and of the best quality.
- B. If a specified product is discontinued by the manufacturer and is no longer available for purchase, seek the guidance of the Owner and Design team. In general, the replacement product shall be of equal or greater value, performance and function as the discontinued Basis of Design product.
- C. Not all products required for a professional, fully functional Audio Video system have been enumerated within these specifications. Provide all products necessary for a complete and working system including those not expressly identified within these documents. Items not specifically referenced may include, but are not limited to, cables, connectors, mounting products, interface cabling etc.

2.2 Basis of Design

- A. The Basis of Design products for the Work of this Division are designated explicitly within these specifications. The combination of Basis of Design products and the interconnection thereof collectively represent the work that includes the feature set and performance intended by the Designer and the Owner. The specifications may identify additional manufacturers whose equipment may be used in the system, provided the use of such products achieves the same capabilities, performance and physical size limitations as that of the specified combination of the Basis of Design products.
- B. Work of the Contract shall include covering the cost of additional products and labor necessary to achieve the same end results as would be achieved by using the specified combination of Basis of Design products, including additional costs

for coordination, modifications to the building, pathway modifications, casework and furniture modifications, power modifications, licensing, or anything else that may cause additional expense to the Owner.

2.3 Substitutions

- A. A substitution is the use of any product other than that identified as the “Basis of Design,” the “Standard of Quality,” or an “Additional Approved Product.” Substitutions require owner / design team approval pre- and post-contract award. Substitutions are considered on a product-by-product and model specific basis.

2.4 System Devices

- A. Equipment Racks
1. Basis of Design: Middle Atlantic
 - a. Alternate Manufacturers: CPI, Great Lakes
- B. Podium Blower Fan
1. Basis of Design: Middle Atlantic CAB-COOL50
 - a. Alternate Manufacturers: CPI
- C. Credenza Blower Fan
1. Basis of Design: Middle Atlantic C3 Fan Kit
 - a. Alternate Manufacturers: CPI
- D. Flat Panel Displays
1. LED Backlit
 2. Resolution: 3840 x 2160
 3. Brightness: 500 Nit
 4. HDR 10
 5. Rated for minimum 16 hours daily operation
 6. RS232 Control input
 7. Basis of design: Newline STV Plus
 - a. Alternate Manufacturers: LG, Sharp, Samsung, NEC
- E. CreateBoard Flat Panel Display
1. LED Backlit
 2. Resolution: 3840 x 2160
 3. Brightness: 400 Nit
 4. HDR 10
 5. Rated for minimum 16 hours daily operation
 6. Interactive touch screen
 7. Basis of design: LG TR3PN
 - a. Alternate Manufacturers: None.
- F. Flat Panel Display Wall Mount
1. Tilting display mount

2. Ultra-slim profile
 3. Extendable arm
 4. Basis of Design: Mount-It MI-309
 - a. Alternate Manufacturers: Chief, Peerless
- G. Sim Room Flat Panel Display Wall Mount
1. Tilting Display Mount
 2. Extendable Swivel Arm
 3. Basis of Design: ULINE Wall Monitor Mount
 - a. Alternate Manufacturers: Peerless
- H. Flat Panel Display Cart Mount
1. Fixed Display Mount with Laptop Shelf
 2. Basis of Design: ULINE Flat Screen Cart Deluxe
 - a. Alternate Manufacturers: Peerless
- I. Flat Panel Display Mount Component Storage
1. Basis of Design: Chief Proximity Component Storage Panel, Interface (display mount)
 - a. Alternate Manufacturers: Peerless
- J. Ceiling Component Box
1. Basis of Design: Chief 1' x 2' Above Suspended Ceiling Storage Box
 - a. Alternate Manufacturers: Peerless
- K. IP Video Encoder/Decoder
1. Built-In Scaling
 2. Built-In USB Extension
 3. Basis of Design: Extron NAV E 501/NAV SD 501
 - a. Alternate Manufacturers: None.
- L. HDMI Switcher
1. Four Input 4K/60 HDMI Switcher
 2. Basis of Design: Extron SW4 HD 4K Plus
 - a. Alternate Manufacturers: None.
- M. USB Extender
1. Basis of Design: Extron USB 3.0 Extender
 - a. Alternate Manufacturers: None.
- N. Button Control Panel
1. Basis of Design: Extron EBP 200
 - a. Alternate Manufacturers: None.
- O. Tabletop Touch Screen Control Panel
1. Basis of Design: Extron TLP Pro 835T
 - a. Alternate Manufacturers: None.

- P. Control Processor
 - 1. Basis of Design: Extron IPCP Pro 250 xi
 - a. Alternate Manufacturers: None.
- Q. Wireless Display Interface
 - 1. Basis of Design: Creston AirMedia
 - a. Alternate Manufacturers: None.
- R. PTZ Camera
 - 1. Basis of Design: Aver CAM 520 Pro3
 - a. Alternate Manufacturers: None.
- S. Fixed USB Camera
 - 1. Basis of Design: Huddly IQ
 - a. Alternate Manufacturers: None.
- T. Beam Forming Microphone
 - 1. Ceiling Mounted Microphone
 - 2. Basis of Design: Shure MXA925
 - a. Alternate Manufacturers: None.
- U. Wireless Microphone System
 - 1. Basis of Design: Shure QLXD124/85-G50
 - a. Alternate Manufacturers: None.
- V. Audio Processor
 - 1. Basis of Design: Shure ANI22
 - a. Alternate Manufacturers: None.
- W. Audio De-Embedder
 - 1. Basis of Design: Extron DA2 HD 8K AE
 - a. Alternate Manufacturers: None.
- X. Amplifier
 - 1. Basis of Design: Extron XPA 2001-70V
 - a. Alternate Manufacturers: Creston, QSC
- Y. Audio Volume Control Module
 - 1. Basis of Design: Extron MLA VC10 Plus
 - a. Alternate Manufacturers: None.
- Z. Ceiling Mount Speaker
 - 1. Basis of Design: Biamp Desono DX-IC6
 - a. Alternate Manufacturers: QSC, JBL, STEM

AA. Sound Bar Speaker

1. Basis of Design: Biamp Parle VBC 2800
 - a. Alternate Manufacturers: QSC, JBL, STEM

BB. Sound Bar Speaker Mount

1. Basis of Design: Chief PACSBM Universal Soundbar Mount
 - a. Alternate Manufacturers: Peerless

2.5 Cabling and Connectors

A. Cable General Requirements:

1. Fixed installation cables shall be UL Listed and NEC type acceptable for the location, application and manner of installation.
2. Within a building, cables that are not installed in a totally enclosed pathway system shall be UL plenum rated .
3. Cables used for below grade applications, in-grade floor boxes, and cables used in pathways that may reasonably end up with standing water within them, shall be manufacturer rated for continuous contact with water without performance degradation or compromise in warranty.
4. Provide cable that meets or exceeds the technical requirements of the components being interconnected suitable for the length and signal type and communication speed carried.
5. Provide cable of sufficient gauge to ensure that connected components receive adequate voltage, power and signal integrity to ensure reliable operation of the system.
6. Supply shielded version of cable for interconnection of system components that require such for proper operation.
7. Manufacturers: Belden, Crestron, Extron, Liberty, West Penn Wire, General Cable.

B. Connectors General Requirements:

1. Terminate every conductor; no cable shall contain unterminated elements unless otherwise indicated. Make terminations only at indicated outlets, terminals, cross-connects and patch panels.
2. Cables shall be terminated with connecting hardware of same category as cable rating or higher.

2.6 Connection Plates and Panels

A. In addition to locations identified on the drawings, provide connection plates/panels:

1. At wall, floor and ceiling equipment locations that accommodate interconnection of portable or movable equipment.
2. At video display equipment locations.
3. At surface mount devices that are not installed with a direct pathway connection.

4. At wall, floor, and ceiling boxes where the cable terminates in a piece of equipment that does not mount in/over the box.
- B. Provide custom manufactured plates/panels when pre-manufactured standard plates/panels are not explicitly specified.

PART 3 - EXECUTION

3.1 Work and Workmanship

- A. Provide labor, materials, equipment and services necessary for complete installation of systems required to comply with the requirements of authorities having jurisdiction (AHJ), as indicated within the Contract Documents.
- B. Work shall be functional and complete in every detail, including items required to complete the system, regardless of whether each necessary item is fully enumerated in the Specifications, Appendices or shown on the Drawings.
- C. Wherever tables, schedules or equipment lists show quantities, they shall not be interpreted to represent the total contract quantity requirement, but instead a portion of the Contract requirement. The Contractor shall be responsible for the higher quantity communicated by the Drawings, within the Specifications and on the schedules/tables. Seek clarification should a discrepancy be found.

3.2 Grounding

- A. Implement signal and safety grounding and bonding to ensure the safety and performance of the system, its operators and the facility in which it is located.

3.3 Mounting and Support

- A. Provide professionally engineered and professionally manufactured mounts and supports for non-portable products. Follow the recommendations of the manufacturer for installation.
- B. Except where code or the Contract Documents require a higher rating, a minimum safety factor of (5) shall apply to the structural integrity of product mounting methods.

3.4 Equipment Racks and Equipment Enclosures

- A. Provide vertical and horizontal wire management products to secure and manage cables.
- B. Provide horizontal wire support bars. Secure bars in such locations as to achieve a professional balance between cable support, equipment accessibility, service and appearance.
- C. Install service loops. Service loop length shall be determined as follows:

1. Long enough that the cable can be relocated to a variety of other compatible ports on the product, sufficient to enable the cable to be landed on a different port if it is incorrectly landed.
 2. Long enough that it can be moved aside without becoming unplugged, being damaged or stressed while attempting to access another nearby connection.
 3. Long enough that no stress is applied to the cable itself, a conductor, any other cable, or connectors on the equipment.
 4. Short enough not to hinder serviceability of an adjacent product.
- D. Power Distribution:
1. Install power distribution products to serve system equipment.
 2. Install not less than 20 percent usable spare outlets that are free, clear, and available for future use.
- E. Install filler panels for unoccupied spaces. Provide a mixture of vent and blank type panels that enable manufacturer requisite airflow over equipment for cooling.
- F. Bundle cables carrying different signal formats and levels separately into independent bundles. Separate bundles with an air space sufficient to prevent interference that adversely affects performance.

3.5 Identification

- A. The identification system shall be a coordinated system of permanently affixed labels that are used to uniquely identify each instance of a product and the space in which it is located. The following items shall be identified:
1. Cables. All cables shall have cable ID on the jacket at each end 4-6 inches from termination.
 2. Patch Panels.
 3. Faceplates.
 4. Individual connection jacks, receptacles and terminals.
 5. Remote Equipment enclosures/cabinets not within telecommunications rooms.
 6. Equipment racks and cabinets.
 7. Device boxes, junction boxes, pull boxes, floor boxes, wall boxes, ceiling boxes and other forms of boxes used for passage, splicing, or termination of cables.
 8. Equipment power cord plugs.

3.6 Projectors

- A. Provide manufacturer recommended lens for each projector.
- B. Prior to installation of the support structure, verify that the target location is currently, and is planned to remain free and clear of obstacles that may adversely affect installation or the performance of the projection system. Coordinate with other trades to remediate conflicts.

- C. Proactively coordinate the location of power receptacle(s) to ensure they are initially located near the projector in a position that affords minimal power cord length.
- D. Perform projector manufacturer recommended post-installation adjustments, including, but not limited to, zoom, focus, aspect ratio, convergence, focus, clock and phase.
- E. Color match projectors whose images are displayed side-by-side.

3.7 Flat Panel Displays / Monitors

- A. Install displays in locations identified on the drawings, and mount at the height(s) designated.
- B. Install display using mounts that are rigidly supported and braced from building structure.
- C. Install display so that it is securely attached to the mount. Furnish and install security straps and/or other security products recommended by the mounting hardware and display manufacturers.

3.8 Cameras

- A. Install cameras at the locations and heights identified on the drawings.
- B. Neatly bundle, dress and conceal cables from view.
- C. Adjust camera settings to achieve optimal performance following the manufacturer's recommendations.
- D. Setup and store site specific user-beneficial presets in cameras and related control equipment.

3.9 Speakers

- A. Speakers destined for installation in suspended ceilings shall be installed using an accessory tile bridge that spans tiles and supports the speaker from the metal ceiling grid system. For secondary support, an accessory safety cable shall be provided to support the speaker from the structure.

3.10 Control Devices and Interfaces

- A. The Software performance shall be robust, predictable, reliable and stable.
- B. User interfaces shall accurately reflect the state of the system and controlled devices.
- C. Normal use of the system, including new-user encounters with the system, shall not result in a lock up of any portion of the system.
- D. System operation shall be restored to normal following a power failure to any controlled component or a control component.
- E. E. The Software shall perform to the satisfaction of the owner / owner's representative.

3.11 Systems Testing

- A. Tests shall be performed on the system to the degree necessary to confirm that the system is fully usable to the Owner for its intended purpose.
- B. 2. Tests shall be performed to confirm that the products are performing according to manufacturers' specifications.

3.12 Training

- A. Provide two (2) hours of training for each unique system type as described in these specifications.
- B. Video record all trainings and make available to the owner.
- C. Provide "cheat sheets" or handouts depicting basic operations of the system for quick reference
- D. Include hands-on demonstrations covering typical uses of the system in day-to-day operation.
- E. Include training covering how to set up and use the system for each type of event.
- F. Include training on preventative and routine maintenance measures that are important to long-term reliability and operation of the system.

END OF SECTION – 274100

SECTION 281643 – ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Submit Manufacturers technical data for each product, including related accessories. Furnish a material list with technical data documenting the location and primary function, quality and performance of each material component or system to be used in the work, or other such primary characteristics as required by the drawings or specifications.

1.2 SCOPE

- A. This section details product and execution requirements for (Access Control System) Security Management System (SMS) for the project.
- B. Expand the existing Galen Avigilon Access Control System.
- C. Work includes furnishing all labor, materials, tools and equipment, and documentation required for a complete turnkey working system as specified in this Section. SMS shall consist of but not be limited to Door Controllers, Card Readers, Sensors, Switches, Conduit, Boxes, Cable and Wired Devices. Programming and cardholder enrolling are also considered as part of installation as well as coordination with Owners existing systems and Credentials.
- D. Unless noted otherwise, "Contractor" shall refer to SMS Integrator & Installer.

Communications routing from SMS to door controllers shall be via Owner LAN.

1.3 RELATED WORK

- A. Related Division 28 Sections include:

282300 - VIDEO SURVEILLANCE

1.4 REFERENCES AND STANDARDS

- A. Work under this Section is subject to requirements of General Requirements.
- B. Other applicable standards are as follows:

UL 294 - Access Control System Units.
UL 1076 - Proprietary Burglar Alarm Units and Systems.
FCC Rules and Regulations Part 15, Radio Frequency Devices
- C. All work and materials shall conform in every detail to rules and requirements of National Fire Protection Association, State and Local Codes, and Industry Standards, and all Industry and BICSI Standards related to DATA Cabling.
- D. All materials shall be listed by UL and shall bear UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has, an applicable system listing and label entire system shall be so labeled.

1.5 DEFINITIONS AND ABBREVIATIONS

- A. SMS – Security Management System

1.6 WORK BY OWNER

A. Owner shall:

Provide list of cardholders for initial SMS programming by Contractor.

Provide scheduling of each door, including:

Alarm activations and distribution.

Door lock and unlock.

Cardholder validation by day and time.

Delay time of door open alarm.

Duration of lock activation upon credential authorization.

1.7 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. System Design drawings with cable routing, device location and labeling.
- C. Operation statements for all SMS doors.
- D. Communication Closet layout drawings.
- E. Certifications for BICSI and any Industry Organizations.
- F. Owner Operation Manuals for all installed equipment as well as documentation of all programming.
- G. As built drawings showing cable pathways and routing. As built drawings to also show any changes made to original ESS drawings.
 - 1. Sustainable Design: LEED submittals conforming to requirements listed in section 013329.02 “Sustainable design reporting – LEED v 4.”
 - a. Provide any of the following documentation: Greenscreen V1.2 benchmark, health product declaration (HPD), Environmental product Declaration (EPD), Pre-consumer and post-consumer recycled content, FSC certified wood, or other documentation as defined in “Sustainable design reporting” – LEED v4.
 - b. Failure to provide above documentation will disqualify products where this documentation is required for LEED compliance. Reference “Sustainable Design reporting – LEED v4.
 - c. Indoor Environmental quality Credits:
 - 1) Product Data for wet-applied products, indicate VOC content, emissions and volume.
 - 2) Laboratory test reports: For applicable building materials, indicate compliance with requirements for low-emitting materials
 - 3) Where applicable, provide formaldehyde-free documentation.
 - d. Sustainable Design:
 - 1) LEED submittals conforming to requirements listed in section 013329.02 “Sustainable design reporting – LEED v4”
 - a) Provide any of the following documentation: NSF61 and NSF 372 Certification, or other documentation as defined in “sustainable design reporting.

1.8 QUALITY ASSURANCE

- A. Security Management System Contractor shall:

Have successfully completed two (2) Security Systems projects in equal magnitude of the system specified in following sections. Contractor shall be an Authorized Integrator in good standing. Proper proof of certifications will be submitted at time of Bid. Comply with all certification requirements set out as it relates to the installation of DATA cabling. Specifically, contractor will certify DATA cabling is being installed by BICSI certified installers and installation supervised by a registered in good standing RCDD in the full-time employee of the project contractor.

1.9 GUARANTEE

- A. Warranty requirements for Security Management System (SMS) shall be 1 (1) years on all parts and labor commencing on Date of Substantial Completion. Those requirements apply to all components covered in this section

PART 2 - PRODUCTS

2.1 GENERAL

- A. Security Management System shall provide ability to:
- Unlock electrified door locks upon authentication of submitted credential to local card readers.
 - Monitor door alarms and remotely unlock.
 - Lock doors on an automated schedule from central system.
 - Unlock doors as required by code via fire alarm relays.
 - Annunciate intrusion alarms from remote sensors.
 - Unlock individual doors manually via operator interface.
 - Lock doors from central Operations Center.
- B. System must support the HID iClass, Multi Class Card Readers and Credentials.

2.2 SMS Software and Database Management:

- 2.3 Annual Software Maintenance Fees shall not be acceptable. SMS Software shall be supported by the manufacturer to the authorized reseller at no annual fee. The current major version of the released version and the previous released version of the software and all sub-versions of the current and previous major version shall be supported.
- 2.4 Reader License charges. There shall be no Reader License Fees, software having Reader License Fees based on the number of readers supported by the software package shall be unacceptable.
- 2.5 Upgrades or expansion of the SMS to a larger size system in scale shall not require installation of a different and or new SMS application or require the administrator / operator to learn a different and or new interface from the previous version.
- 2.6 The SMS shall be written using recognized standard software coding techniques. The SMS shall be written to support multiple languages without re-engineering. The SMS software shall be written to Microsoft's published standards for User Interface Design, Secure Coding Practices and Database Implementation Guidelines.
- 2.7 The SMS architecture shall support Microsoft Windows Clustering, Hot-Standby, Fault Tolerant Servers, Fault Tolerant Hot Standby Servers, and Virtual Servers.

2.8 The SMS shall be capable of importing or updating Cardholder data using the following source types.

1. Microsoft Access
2. Microsoft Excel
3. Microsoft SQL Server
4. ASCII Text (delimited file)

2.9 The SMS or equal shall support:

1. Multiple Sites, (Partitioning, or Segmenting)
2. 1000 System Control Panels (SCP)
3. Support for 256 Tasks per SCP
4. 64,000 Access Control Readers, 64 readers per SCP.
5. 512,000 Inputs, 512 per SCP
6. 512,000 Outputs 512 per SCP
7. Supports multi-drop OSDP readers with EP/LP SIO devices.
8. Unlimited Cardholders
9. Multiple Cards per Cardholder
10. 32,737 Access Levels
11. 128 Access Levels per Card
12. 255 Time zones, with 12 start/stop intervals each
13. 255 Holidays, across 8 Holiday Groups/Types
14. Elevator Control using 64 Floors with 255 Floor Codes
15. Support for KONE destination dispatch elevator control.
16. Support for OTIS destination dispatch elevator control
17. Support for Schindler destination dispatch elevator control.
18. Anti-Passback with Occupancy Counting
19. Virtualization Support
20. Video Integration Support

21. Zenitel Intercom integration support.
22. Biometric Integration Support
23. Web Client / Thin Client Support
24. Fully Integrated Graphical Mapping (Floor Plans with Active ICONs)
25. Definable Report Support, with the ability to Hyperlink recorded video directly from within a Report to play back recorded video in a single step operation.
26. Unlimited User Definable Macro Support per site.

2.10 Lock Integration support for:

1. ASSA ABLOY
2. Allegion
3. Salto Sallis, SX4 & SVN

2.11 SMS Software and Field Hardware Warranty. The SMS Software shall be warranted for a period of 90 Days from the date of shipment from the manufacturer to be free of defects and will function in substantial accordance to the published specification.

1. SMS Field Hardware shall be warranted for a period of three (3) years from the date of shipment from the manufacturer, will be free from defects and will function in general accordance with the product specifications.
2. SMS Third Party Device warranties are transferred from the manufacturer to the contractor, which may then transfer third party warranties to the owner. Specific third party warranty details, terms and conditions, remedies and procedures, are either expressly stated on, or packaged with, or accompany such products. The warranty period may vary from product to product. These products include but are not limited to devices that are directly interconnected to the SMS field hardware or computers and are purchased directly from the SMS manufacturer. Examples may include but not be limited to; Credential Printers, Reader Heads, Biometric Devices, Computers etc.

2.12 The SMS shall use Microsoft SQL Server Express 2008 R2 or higher as the database engine.

2.13 The SMS shall be capable of utilizing a Web client. The Web client shall be capable of being utilized via any standard Browser to include but not limited to Microsoft Internet Explorer, Mozilla Firefox, Google Chrome, Opera, Apple Safari, IOS Browser, and Android Browser. The Web client shall be device aware such that it shall display according to the device it is being used from with larger buttons on a mobile device such as a Tablet or Phone. The Web client shall require the User to log in and shall utilize User Groups to allow commands / functions available to the User if at a Desktop (i.e. change reader mode, find, a cardholder/card, interact with cardholder/card, execute a Macro, change an Access Level.

2.14 SMS Software Interface

1. The SMS Software shall be Microsoft Windows compliant having a Microsoft “Outlook” type structure.
10. The SMS shall be capable of tracking Cardholders, Cards, or Readers in a separate Tracking Screen\Window for those items being Tracked (watched).
 - a. The SMS shall be capable of permitting a User to set the number of historical Tracking events to search for and display when the workstation is started (signed in/logged in) allowing the User to immediately view Tracked / Watched item events without creating and running a report.

2.15 The SMS shall be capable of having Digital Video Recording / Network Video Recording integrations.

2.16 Biometric Integration

1. Allegion – HandKey
2. Suprema BioConnect – FingerPrint / Facial Recognition
3. Eyelock

2.17 NETWORK SMS

The SMS shall communicate with, monitor, and use open architecture System Control Processor (SCPs), which shall support 64 controlled openings per, EP – 1502, EP – 2500, EP – 4502 EP-4502 with Auxiliary Authentication Module (AAM), the LP4502, LP2500, LP1502, LP1501 SCPs.

The EP – 1501 and LP-1501 (SCP) shall support a total of 17 openings. The SMS shall be capable of communicating with a minimum of 1,000 SCPs concurrently for a minimum of 64,000 controlled openings.

The SMS shall not employ reader licenses which limit the number of Readers the SMS shall control.

The SMS shall be capable of communicating with the SCPs using Hardwire (direct RS-232, or RS-485), and TCP/IP network communications.

Each SCP shall be capable of maintaining in its memory a Real-time clock, 256 Holidays, 128 Time Zones each having 12 start\stop Time Intervals, 32,000 Access Levels, 256 Tasks (predefined routines with 256 steps per Task), 8 Card Formats (up to 19 digit card codes, 8 Facility (Site) codes, supports Open Supervised Device Protocol (OSDP) multi-drop support with series 3 Mercury hardware, supports Anti-Passback (areas, hard, soft, timed, nested), occupancy count rules, device configurations for the devices (Readers, Inputs, Outputs) controlled by the SCP, and a minimum of 50,000 event transactions if the SCP is unable to communicate to the SMS, the SCP stores Card numbers for entry decisions.

- 2.18 System Input Output (SIO), Reader Interface Modules (RIM), such as the MR-50 single (opening) reader interface, MR-52 dual opening or single opening with in out reader interface control,

and MR-51E single opening control supports dual readers for IN \ OUT control or the Series 3 MR-50, MR-52, MR-62e.

2.19 System Input Output (SIO), 16 dry contact Input modules with 2 Form C output relays, and 16 form C relay Output modules, such as the MR-16IN, or the MR-16OUT or the series 3 MR-16IN, MR 16-OUT, SIO devices.

2.20 The SMS shall also have the capability to integrate \ communicate with wireless \ IP locksets, Intrusion Systems, and Biometrics.

2.21 The SMS shall be capable of utilizing PVC badge printer having a Windows compliant \ capable Windows Driver for the Operating System being utilized for the SMS Workstation Software. The SMS shall utilize standard Dot Matrix, Laser, and Ink jet printers for report purposes having a Windows Driver for the workstation the printer is connected to.

2.22 PROXIMITY CARD READERS

Manufacturer: HID.

Wall-mount: Model RP40 (6125C) iClass Standard Reader.

Mullion-mount: Model RP15 (6145C) multiCLASS.

Manufacturer: Essex Electronics.

Turnstile Reader: Model IRXPT-MXO iClass Reader

Reader(s) shall:

- a. Be furnished in Wiegand output model and shall be sealed in a polycarbonate enclosure designed to withstand harsh environments.
- b. Unless otherwise specified, reader covers shall be furnished in "black" color – Classic design.
- c. Recognize 125 kHz and iClass 13.56 MHz signals
- d. Contain an indicator to indicate valid and invalid card
- e. Be designed for ambient operating environment.
- f. Be powered remotely using centralized power supplies.
- g. Read iClass Corporate 1000 sector information
- h. Include Near Field / Bluetooth capabilities.

2.35 DOOR CONTACTS (DPS / Monitor Points when not included in Door Hardware)

Manufacturers: GE Interlogix 1078 Series or approved equal.

2.23 REQUEST-TO-EXIT MOTIONS SENSORS (When not included in Door Hardware)

Manufacturers: GE, Honeywell, or approved equivalent.

1. Provide door header mounted request to exit motion sensors as indicated on Drawings.
2. Minimum Specifications
 - a. Detection technology Passive infrared
 - b. Detection pattern Narrow beam 35-degree cone
 - c. Output contact normally open contact is closed when sensing zone is entered or exited

- d. Power requirements 12 – 24 VDC
- e. Mounting: Door header

2.37 DURESS BUTTON:

Dual button hold-up switch that is designed to generate an alarm condition only when both buttons are pressed simultaneously, thus preventing accidental triggering

Manufacturer: Amseco Model - HUSD-15BL/BM

2.38 POWER SUPPLIES

As required to support Card Reader(s), Door Controller(s), Strike(s), Sensor(s), and other components for fully operational turnkey system. Each component connected to power supplies shall be independently fused with rated fuses to match the manufacturer requirements for each specific device. Power supply cabinets shall have door locks included and keys shall be turned over to Owner at substantial completion.

Electrified Door hardware power supplies shall be specified by Division 8. Each component connected to power supplies shall be independently fused with rated fuses to match the manufacturer requirements for each specific device

2.39 CABLING

General

Cable shall be: Plenum Rated.

Reader Cable Construction: 18 AWG stranded or as recommended by system manufacturer.

Aluminum/Mylar shield with drain wire applied over assembled conductors.

a. Door Lock Power Cable

Provide and install as required for door hardware. Refer to Architectural Door Schedule and Door Hardware documents.

b. Door Contact / Signal Cable

Door Contact/Signal Cable used for monitoring purposes.

Construction: 22 AWG twisted, stranded or as recommended by system manufacturer.

Aluminum/Mylar shield with drain wire applied over assembled conductors.

c. Request-to-Exit Motion Detector Signal Cable

Motion Detector Signal Cable used for monitoring purposes.

Construction: 20 AWG stranded or as recommended by system manufacturer.

Aluminum/Mylar shield with drain wire applied over assembled conductors.

d. Door Controller Cable

Provide all LAN patch cables, jacks, and faceplates

PART 3 - EXECUTION

3.1 PRE-INSTALLATION COORDINATION

- A. Coordinate with Electrical Contractor (Division 260000) that:

Section 280000 provided pathways and equipment back boxes are completed and are coordinated with no conflicts for system installation.
Adequate power has been provided and properly located for security system equipment.
Code-complying fire alarm relays will be installed for cable termination.
Fire Alarm contractor will provide relay contacts in Com Closet for connection to Access control panels. Contractor is responsible for coordination with Fire Alarm Contractor. Access control Contractor shall provide all parts and pieces including all cabling from Access control panel to Fire Alarm Contact point.
Coordinate scheduling of work to make sure there are no conflicts.

- B. Coordinate with Door Frame supplier (Division 8):

Doors and door frames are properly prepared for electric locking hardware and door position switches are furnished by door type.
Locations of all devices prior to installation.
Electric door power supply locations and connections requirements.

- C. At a minimum, coordinate the following with Owner:

Owner-provided IP addresses for SMS devices.
Network infrastructure requirements at SMS head-end.
Initial database programming.
Planned system downtime.
Programming and training for new system.

- D. Coordinate with Construction Manager as required providing a fully functioning turnkey Security system.
- E. Coordinate with all trades on the operation and installation of ADA entrance doors with relation to Card Readers and interconnection with door actuator plates, motor units, Fire Alarm System. Contractor will supply any and all associated timer boards or additional parts required for complete operating doors system.

3.2 INSTALLATION

- A. General

Verify acceptance of each type of specified request-to-exit hardware for each application with local life safety code officials.
Provide tamper proof fasteners for all equipment in public areas. Fastener finish shall match equipment finish.
Maintain minimum three feet of access in front of class 1 electrical equipment.

- B. Delivery, Storage, and Handling

Deliver products to and receive products at site under provisions of General Requirements.
Materials shall be stored according to manufacturer's recommendations at minimum.

C. Equipment

Provide equipment as indicated on Drawings and specified herein. Additional specific installation requirements are as follows:

Door Controllers

Provide Door Controllers in Data Closets.

Provide connection to 120 VAC via hardwire conduit. Coordination with Division 260000.

Separate 24 VDC and 120 VAC, wire, cable, and devices by 12" minimum space.

Enclose wire and cable in wire ways or bundle with wire exiting wire ways to terminal strips or panel mounted devices.

Space controllers according to manufacturer's requirements. Ensure adequate space is allowed for device heat dissipation.

Do not place controller or control devices on enclosure sides.

Card Readers

Provide card readers and card reader devices as shown on Drawings.

Wire card reader LEDs to indicate valid and invalid card reads, and door locked and unlocked conditions. All card reader LED indicators shall operate identically throughout Project. LED shall be red in normal, secured state, and shall be green on valid card read and while door is unlocked.

Electric Locking Mechanics

Interface with electric locking mechanics as required by the door hardware.

Provide lock control of electrified locking mechanics through output contacts activated by Door Controller.

Electrified Panic Devices

Interface with electrified panic devices as indicated on Drawings. Provide all low-voltage wire and connections between SMS power transfer device and electric locking mechanics.

Provide lock control of electrified panic devices through output contacts activated by Door Controller. Provide all 120VAC if required for Device operation per hardware specifications. Provide connection to Fire Alarm connection points as required by Code. Fire Alarm Contractor to provide relay contacts in Com closets for this purpose. Contractor is responsible for all parts and pieces including cable from Access control panel to the Fire Alarm relay contract. Contractor is responsible for coordination with Fire Alarm contractor.

Door Position Switches

Install as shown on drawings.

Coordinate pathways.

Request-to-Exit Motion Sensors

Provide as shown on drawings.

Coordinate pathways.

Fire Alarm Interface (If required per local codes)

Connect (hard wire) door controller to building fire alarm system for fail-safe release upon any fire alarm.

Interface with low voltage / low current normally closed dry contact from fire alarm system provided by fire alarm Contractor (verify exact location in Data Closet for connection with FA). Contact shall open on any fire alarm condition.

Provide all additional UL listed fail-safe relays and power supplies necessary to interface to this contact and unlock all fail-secure doors.

Coordination Meetings with Fire Alarm Contractor shall be scheduled and coordinated with construction team.

Cable Installation

Visually inspect all wire and cable for faulty insulation prior to installation.

Furnish and install all specified wire and cable as required for functioning SMS system.

Neatly lace, dress and support cabling.

Pull cables in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 Standards.

- 1) Do not exceed manufacturer's recommended pulling tensions.
- 2) Do not install bruised, kinked, scored, deformed, or abraded cable.
- 3) Do not splice cable between indicated termination, tap, or junction points.
- 4) Remove and discard cable where damaged during installation and replace it with new cable.
- 5) Pull all cable by hand unless installation conditions require mechanical assistance.

Run all wire and cable continuous from device location to final point of termination. No mid-run cable splices shall be allowed.

Cables shall not be attached to existing cabling, plumbing or steam piping, ductwork, ceiling supports, or electrical or communications conduit.

Cable shall never be laid directly on a ceiling grid or attached in any manner to ceiling grid wires.

Furnish and install all cable such that ample slack is supplied at device terminating end of cable to compensate for any final field modifications at install locations.

- 6) Loosely coil slack in "Figure-eight" in a manner that prevents kinking.
- 7) Loop radius shall be at least 4X minimum bend radius for cable.
- 8) Slack length of cable shall be 4 feet (minimum).

Provide code-compliant fire proofing techniques for all penetrations of fire rated partitions and slabs, where penetrations are made by or used for installation of SMS System.

Coordinate routing of wire and cable requiring isolation from power, radio frequency (RF), electromagnetic interference (EMI), telephone, etc. with General Contractor.

At no time, shall any cable be subjected to a bend less than manufacturer's specified minimum radius. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on Wire and Cable.

Make connections with solder-less devices, mechanically and electrically secured in accordance with manufacturers' recommendations. Wire nuts shall not be an acceptable means of connecting wire and cable.

Utilize conduit and cable trays and or pathways to route SMS cables from each door or device to Door Controller.

No A/C current-carrying conductors are allowed in same pathway as signal or low-voltage power cables.

Wire and cable within Door Controllers, enclosures and or other security enclosures shall be neatly installed, completely terminated, pulled tight with slack removed and routed in such a way as to allow direct, unimpeded access to equipment within enclosure. All wire and cable shall be bundled and tied. Ties shall be similar to T&B TyRap cable ties.

Use of electrical tape for splices and connections shall not be acceptable.

Make connections with solder less devices, mechanically and electrically secured in accordance with manufacturers' recommendations. Wire nuts shall not be an acceptable means of connecting wire and cable.

All system cabling within vertical risers (as required) shall be bundled, wrapped and tied to structure at three-meter intervals in order to isolate it from other wire and cable within riser. Additionally, all wire and cable within shaft shall be supported at least every two floors using Greenlee Slack Grips (Split Mesh Lace Closing) or approved equal. Provide all personnel and equipment necessary to install and support cable. All equipment shall be UL listed for application.

D. System Programming and Data Entry

Collect all data required to make the Security Management System operational. Deliver data to Owner on data entry forms, utilizing data from Contract Documents, Contractor's field surveys and all or pertinent information in Contractor's possession required for complete installation database. Identify and request from Owner any additional data needed to make SMS System fully operational and integrated. Completed forms shall be delivered to Owner for review and approval at least 30 days prior to Contractor's scheduled needed date. Provide all initial system information for SMS setup including, but not limited to following:

SMS Card Reader Information

- 1) Coordinate all card reader values and text, including descriptors, alarm messages, map call up and identification.

Input and output points for SMS. Coordinate all input and output priorities and text, including descriptors, alarm messages, and identification.

Initial system users, including levels of access. This shall include designation of Owner's representative at "Super User" level immediately upon SMS initialization.

- E. Furnish and install all SMS wire and cable including DATA cabling.
- F. Provide code-compliant fire proofing techniques for all penetrations of fire rated partitions and slabs, where penetrations are made by or used for installation of SMS.
- G. 120 VAC power dedicated to security system shall be on provided Emergency Generator Power. Servers shall be on properly sized UPS units on Emergency Generator backup circuits.
- H. Connect to AC power with provided UL listed power supplies and transformers to distribute low voltage power to system components as required.
- I. Provide hinged cover UL listed terminal cabinets with tamper switches for all power supplies, transformers and power distribution terminal strips. Provide all conduit and wiring from AC power facilities to terminal cabinets.
- J. Provide protection against spikes, surges, noise, and or line problems for all system equipment and components.
- K. Provide protection on all exterior, control, power, signal cables and conductors against power surges. Each surge protector shall be UL Listed.
- L. In no instance, shall any UL labeled door or frame be drilled, cut, penetrated, or modified in any way.
- M. Contractor shall be responsible for replacing any labeled door or frame that is modified without written approval from project Engineer.
- N. Label all controls as necessary to agree with their function.

- O. Label all Wire and Cable in common at both ends using a permanent method such as self-laminating cable marking tape.

Tags shall be attached to wire and cable nylon cable ties in an accessible location so that they can easily be read.

Tags shall be installed when wire and cables are installed.

Labeling shall be consistent with existing cable labeling system and agree with Record Documentation.

- P. Place wire identification numbers at each end of conductor involved by using sleeve type, heat shrinkable markers. Markers shall be installed so as to be readable from left to right or top to bottom.
- Q. Mark all connectors with common designations for mating connectors. Connector designations shall be indicated on record drawings.
- R. Coil all spare conductors in device back box, panel wire way, or top of panel where wire way is not provided. Conductors shall be neatly bundled and tagged.
- S. Install integrated security and communication system in accordance with manufacturer's instructions at locations indicated on the Drawings.
- T. Mount equipment plumb, level, square, and secure.

3.3 DEMONSTRATION AND TRAINING

- A. Coordinate with Owner to establish schedule for required training. Provide at least eight (8) hours training. Video record all training and provide said recordings to Owner in DVD format.
- B. Contractor shall be on call during Warranty period to answer any questions Owner might have. The Owner reserves the right to use any excess training hours, not used by time of system completion, for future training as requested by Owner until total number of training hours has been used.
- C. Demonstration:
Demonstrate that integrated security and communication system functions properly.
Perform demonstration at final system inspection by qualified representative of manufacturer working with contractor.

3.4 SYSTEM START-UP

- A. Start-up includes all Contractor-Furnished, Contractor-Installed (CFCI) systems and equipment.
- B. Work shall be complete and ready to operate prior to final acceptance.
- C. All database programming for systems up to inaugural day of beneficial use of Security System shall be coordinated thru Owner.
- D. Adjust integrated security and communication system for proper operation in accordance with manufacturer's instructions.

3.5 SYSTEM ACCEPTANCE

- A. Final acceptance testing of Work will be coordinated and observed by Owner and or Owner representatives.

- B. Prior to testing, Contractor shall submit two sets of preliminary (draft) Record Drawings to Owner. Preliminary Record Drawings are to be used by Owner to conduct system final test.
- C. At completion of Work, remove all waste materials, rubbish, Contractor's and subcontractors' tools, construction equipment, machinery and all surplus materials.

3.6 PROTECTION

- A. Protect installed integrated security and communication system from damage during construction.

END OF SECTION – 281643

SECTION 282300 – VIDEO SURVEILLANCE SYSTEM

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 SCOPE

- A. This section details product and execution requirements for Video Management System for the project.
- B. Work includes furnishing all labor, materials, tools and equipment, and documentation required for a complete turnkey working system as specified in this Section. VMS shall consist of but not be limited to, Cameras, Monitors, Conduit, Boxes, Cable and Wired Devices. Programming and camera view setup are considered part of installation as well as coordination with the Owner and Avigilon.
- C. Unless noted otherwise, "Contractor" shall refer to VMS Integrator & Installer.
- D. Communications routing from VMS Cameras to Servers shall be via Owner LAN.
- E. Coordinate with any and all trade contractors as required to provide a fully functioning system.
- F. Unless noted otherwise, "Contractor" shall refer to security system integrator & installer.
- G. Applicable provisions of Division 1 shall govern all work under this section.
- H. Video surveillance can be restricted or prohibited by law. This document details technical considerations only. It is assumed that registration, licensing, policies regarding disclosure and privacy (notification, processing of images, time and date stamping, recording of sound, etc.), and or legal obligations are responsibility of Owner.

1.3 REFERENCES AND STANDARDS

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 1 General Requirements.
- B. All work and materials shall conform in every detail to rules and requirements of National Fire Protection Association, State and Local Electrical Code, Industry Standards. Any and all DATA cabling for VMS system shall adhere to Division 270000 specifications.
- C. All materials shall be listed by UL and shall bear UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label entire system shall be so labeled.
- D. Other applicable standards are as follows:
 - 1. ANSI/IEEE C2 - National Electrical Safety Code
 - 2. NFPA 70-1999 - National Electrical Code
 - 3. IEEE/ANSI 142-1982 – Recommendations for Grounding of Industrial & Commercial Power Systems.
 - 4. NTSC/EIA RS-170A Video Standard

5. IEEE 802.3 standards for CSMA/CD (Ethernet) based LANs
6. Emissions: FCC 15, Class A; CE: EN55022 (Emissions)
7. CE: EN50082-01 (Immunity)
8. CE, UL 1950; CUL 1950 CE: EN60950 (Safety)

1.4 DEFINITIONS AND ABBREVIATIONS

- A. VMS – Video Management System
- B. LAN – Local Area Network
- C. NVR Server – Avigilon Video Server or approved equal.

1.5 WORK BY OWNER

- A. Owner shall provide:
 1. Verify exact security device mounting locations.
 2. Verify Acceptable per-camera field-of-view information.
 3. IP-address requested for VMS devices as needed.
 4. Network VLAN information if available.
 5. All active LAN components (switches, routers) as requested for security system function.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. System Design drawings with cable routing, device location and labeling.
- C. Security Closet layouts.
- D. Camera View Modeling.
1. Sustainable Design: LEED submittals conforming to requirements listed in section 013329.02 “Sustainable design reporting – LEED v 4.”
 - a. Provide any of the following documentation: Greenscreen V1.2 benchmark, health product declaration (HPD), Environmental product Declaration (EPD), Pre-consumer and post-consumer recycled content, FSC certified wood, or other documentation as defined in “Sustainable design reporting” – LEED v4.
 - b. Failure to provide above documentation will disqualify products where this documentation is required for LEED compliance. Reference “Sustainable Design reporting – LEED v4.
 - c. Indoor Environmental quality Credits:
 - 1) Product Data for wet-applied products, indicate VOC content, emissions and volume.
 - 2) Laboratory test reports: For applicable building materials, indicate compliance with requirements for low-emitting materials
 - 3) Where applicable, provide formaldehyde-free documentation.
 - d. Sustainable Design:
 - 1) LEED submittals conforming to requirements listed in section 013329.02 “Sustainable design reporting – LEED v4”
 - a) Provide any of the following documentation: NSF61 and NSF 372 Certification, or other documentation as defined in “sustainable design reporting.

1.7 QUALITY ASSURANCE

- A. Video Management System Contractor shall:
 - 1. Have successfully completed two (2) Avigilon Security Systems projects in equal magnitude of the system specified in following sections. Be fully certified by Avigilon Systems for Sales and Installation of Avigilon equipment. Proper proof of certification with Avigilon Systems will be submitted at time of Bid.

1.8 GUARANTEE

- A. Warranty requirements for Video Management System (VMS) shall be one (1) years on all parts and labor commencing on Date of Substantial Completion. Those requirements apply to all components covered in this section

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. This specification, the functionality, the products and the system capabilities that are represented herein are based upon capabilities achievable through integration of products from a variety of listed product manufacturers. It is however the responsibility of the Contractor to provide such combination that meets and exceeds all expressed and implied requirements of these project documents. Commercial Security Products from the following manufacturers will be considered acceptable:
- B. VMS Software.
 - 1. Avigilon
- C. VMS Server (hardware)
 - 1. Avigilon
- D. Switches
 - 1. Avigilon
- E. Accessories
 - 1. Altronix
 - 2. Comnet
 - 3. Ditek
 - 4. IFS
 - 5. Vigitron
 - 6. Berktek Leviton
- F. Surveillance Cameras
 - 1. Avigilon
- G. Workstations
 - 1. Dell
 - 2. HP
 - 3. VMS manufacturer workstation.

2.2 Latest Version

- A. Software supplied shall be the latest and most up-to-date official-release shipping version shipping at the time of acceptance.
- B. Hardware supplied shall be the latest and most up-to-date shipping version available at the time of installation, complete with the most current official-release firmware.

2.3 VIDEO MANAGEMENT SYSTEM (VMS)

- A. The system shall feature IP based network video recording of all system cameras.
- B. Provide all licensing to view and record all cameras depicted on the drawings.
- C. The system shall include the ability to record video from selected cameras based upon user defined access control activity.
- D. The system shall include the ability to record video from cameras based upon preprogrammed video conditions;
 - 1. Record at all times
 - 2. Record only during selected times
 - 3. As a result of activity in the view of the camera
 - 4. As a result of setting minimum frames per second regardless of activity (time lapse)
 - 5. Record at different frame rates or image quality based upon predetermined administrator selected conditions.
- E. The system shall log alarm activity and enable users to search video and associated database for such activity.
- F. The system shall include support for recording of all cameras simultaneously and the ability for 10 different computers to view unique combinations of cameras simultaneously.
- G. The system shall be capable expansion in the future to accommodate additional concurrent viewing computers.
 - 1. The expansion shall only require payment of a software license fee and installation of a licensing key to achieve this objective.
- H. The system shall permit all of the following to occur simultaneously:
 - 1. Record all cameras
- I. View all cameras live (i.e. in real time)
- J. Playback pre-recorded video from any and all cameras simultaneously.
- K. The above shall be possible when cameras and/or video storage medium are physically located on premise or at remote facilities.
- L. Video shall be stored in a non-volatile, expandable drive storage system that does not result in loss of data should a single drive unit within a chassis fail or when storage space is added to the system.
- M. Each storage system chassis shall include at least one built-in spare drive unit designed to immediately take over in the event of another drive failure.
- N. Data on the spare/replacement drive unit shall be reconstructed in less than 24 hours while the system continues to operate at normal operating capacity.
- O. The system shall support distributed video storage, whereby storage of video does not need to be in one physical location.

- P. Software shall support archival (back up) of system recordings
- Q. Software based remote control of cameras, associated optics and positioning devices shall be possible by administrator authorized users and groups of users.
- R. Authorized users shall have the ability to create and store preset views containing 1 to multiple cameras.
 - 1. Preset views shall be available for instant recall by the user.
- S. Capable of matching camera resolution to the display or display area used for viewing
- T. Authorized users shall have the ability to create and store preset views containing 1 to multiple cameras in a web-browser
- U. The system shall enable users to search for and play back video by date, time, camera, and alarm condition as well as video analytics.
- V. The system shall support recording and storage of video encoded in multiple (3) or more popular standards-based video encoding formats to accommodate future expansion using cameras from multiple manufacturers.
- W. The system shall include the ability to export pre-recorded camera video of any duration to commonly recognized popular portable storage mediums.

2.4 Image Storage Capacity

- A. Although configuration settings at time of installation will be different, the system shall be provided with storage capacity sufficient to store (30) days of images, based upon the following specific criteria:
 - 1. All system cameras recording simultaneously;
 - 2. Highest scene activity based on camera location;
 - 3. Highest image resolution settings available on system equipment;
- B. Framerate (fps) based on the following criteria:
 - 1. 7fps – General exterior coverage (i.e. parking lots, etc.).
 - 2. 7fps – General interior coverage (i.e. hallways, entryways, etc.).
 - 3. 15fps - Coverage of vehicle right of ways (i.e. gates, parking garage lanes, etc.),
 - a. High traffic areas (high people density).
 - 4. 30fps - Monetary coverage (cash register, table gaming, etc.).
 - 5. Specific framerate called out on plans or details.
- C. 20% additional storage capacity in reserve for future camera additions.

2.5 CAMERAS, MOUNTS & ACCESSORIES

- A. Baseline Camera Features
 - 1. Listed by a national recognized safety testing laboratory (UL or equivalent)
 - 2. 10/100/1000 mbps Ethernet output for transmission of video over IP network
 - 3. Lens Vari-focal
 - 4. Auto-iris / P-Iris lens
 - a. Motorized auto focus
 - b. Camera settings shall be remotely configurable via IP communications
 - 5. CMOS sensor type imaging device

6. Backside illumination
 7. Resolution scalable
 8. Range between HD 1080P - UHD 4K
 9. Bandwidth scalable
 - a. Range between 64 Kbps and 20 Mbps
 10. Light Sensitivity
 - a. 0.3 (color)/0.04 (BW), 0 Lux with IR illuminator on, measured with DSS off at 30 IRE
 11. 480i composite video output for local camera setup
 12. Capable of transmitting 30-progressive frames of video per second at the full native resolution of the camera
 13. Commercial grade camera
 14. Onscreen menu for local camera setup
 15. Auto gain control
 16. Auto white balance
 17. Wide dynamic range
 18. True or digital WDR
 19. Signal to noise ratio $\geq$ 50dB
 20. IR illuminator
 21. Support for powering via Power Over Ethernet (PoE) enabled input, and local power.
 22. Capable of being Low-voltage (12-24 V) powered
 23. Support for one or more of the following standards based encoding algorithms: MJPEG, MPEG-4, H.264 and H.265 (HEVC).
 24. Capable of simultaneously transmitting $\geq$ 3 streams at varying rates
 25. ONVIF Profile S compatible
- B. Additional baseline features of cameras used outdoors
1. Resolution scalable
 2. Range between HD 1080P - UHD 4K or 12 Mega Pixel
 3. Dual modes of operation - Color during normal lighting conditions; black-and-white during low light conditions
 4. Physical auto switching removal of the infrared filter for increased sensitivity in low-light conditions.
 5. Backlight compensation.
 6. Install transient voltage surge suppression protection devices in line with cables connecting outdoor equipment with indoor equipment. Protection device shall provide a margin of protection of outdoor equipment against surges originating within the building and margin of protection of indoor equipment originating from electrical surges outside the building.
 7. Install protection devices in each conductive circuit that interconnects outdoor equipment to indoor equipment. This includes power, video and control circuits.
 8. Protection devices shall be installed within a Ingress Protection (IP65 minimum) rated enclosure installed within 10 cable feet of cable entrance into the building. Enclosure shall be installed above accessible ceiling and sized to accommodate the fully connectorized h. See Labeling for additional requirements.
- C. Additional features for pole-mounted cameras
1. Dynamic Image stabilization feature for reduction of the visual effects of minor pole swaying movement.
 2. Pan Tilt Zoom Cameras (as indicated on drawings)

- a. PTZ control shall be available to operator via Video Management Software or through outboard dedicated PTZ Joystick type of operator control

D. Mounts

1. Provide commercial grade mounts heavy duty mounts and mounting hardware for cameras.
2. Outdoor mounts shall be designed for outdoor mounting and exposure to the elements
3. All outdoor hardware shall be stainless steel (screws, nuts, bolts, straps, etc).
4. Refer to drawings for mounting form-factors of individual camera locations.

2.6 COMPUTERS, MONITORS AND ACCESSORIES

A. General

1. All supplied computers (Servers, Workstations, etc...) and peripherals (monitors etc...) shall meet or exceed the software manufacturers' recommended specifications for running the software and operating the specified system.
2. Computers that meet the VMS manufacturer's "minimum" computer requirements are not acceptable.
3. Computers shall be furnished fully loaded and configured with operating system software client user licenses necessary to allow the system to operate capacity. The operating system and database software shall be the latest version supported by the security system software.

B. Server Computers

1. Provide minimum (1) dedicated rack mount server-class computer to run the Video Management System surveillance server.
2. Provide (1) rack mount LCD monitor (17"-class minimum), plus rack mount computer keyboard and mouse drawer system.
3. Provide servers with operating system, database software and sufficient Client Access Licenses and other applicable licensing to ensure that full operation of the system, and concurrent access by video client software computers.

C. Work Station Computers

1. Provide software and install it on (5) work station computers, that shall be owner furnished or designated. The software shall also be compatible with Mac OS or the Mac OS Microsoft OS simulation.

2.7 MASS STORAGE

A. Hard-disk-drive (HDD) or Solid-state-drive (SSD) based arrays.

1. Expandable without loss of existing data.
2. Self-healing configuration with integral hot-swappable spare drives.
3. Sufficient read/write data bandwidth to accommodate writing of data from all system video sources simultaneously (multiplied by a factor of 4) at the full resolution and frame rate of the video source, plus an equivalent amount of bandwidth for playing back (i.e. reading) data.
4. 19" Rack mountable

2.5 WIRE AND CABLE

A. General

1. Provide and install all device DATA cables as per DATA requirements. DATA cabling for Security cameras shall be terminated DATA Closets. Camera cabling should be terminated in jacks at the camera device. Contractor to provide all patch cables. All exterior camera cables shall be provided with Surge protection units on each cable. Proper cable types must be must as per Industry standards and requirements.
2. Provide all interconnecting system cabling at Closets as well at security device end points.
3. Bond metallic system components in all Closets and Security Closets to existing in-room ground bar.

PART 3 - EXECUTION

3.1 GENERAL

- A. Work performed for installation of VMS system shall be performed by Security System Integrator – “Contractor”.
- B. Provide equipment as indicated on Drawings and specified herein.
- C. Provide all labor and materials necessary to construct systems as described herein to include furnishing and installing all system equipment, interconnecting cabling, programming and start-up, software (including software upgrades and reprogramming as necessary), termination components, mounting hardware, incidentals, accessories, testing, labeling, documentation and training as detailed in following sections.
 1. Neatly lace, dress and support cabling.
 2. Coordinate any downtime with Owner.
- D. Prior to installation:
 1. Conduit and equipment back boxes are as required. Contractor is responsible for coordination with all trades to ensure that conduit and back boxes are correctly placed for VMS use. Contractor is responsible for coordinating installation of conduit and boxes to make sure they are installed on schedule with other trades and are coordinated as to not interfere with other systems or pathways.
 2. 120V AC Power is as required and is properly located.
 3. LAN structured cabling is as required and properly located and installation has been coordinated with other trades.
 4. Coordinate all devices and locations prior to equipment installation with owner.
 5. Coordinate Owner-desired camera views, providing camera modeling prior to installation.
 6. Coordinate Camera housing and mount finishes with Architect and Owner.
- E. Install and wire equipment in accordance with Industry Standards, manufacturer’s recommendations, and accepted engineering and installation practices.
- F. Mount system components as recommended by manufacturer. All equipment mounting in Communication Closets must coordinated with Owner prior to installation.
 1. Arrange equipment to facilitate permanent access for use and maintenance.

3.2 CABLE INSTALLATION

- A. Neatly lace, dress and support cabling.

- B. Pull cables in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 Standards as well as Industry Standards and all Division 270000 requirements.
 - 1. Do not exceed manufacturer's recommended pulling tensions.
 - 2. Do not install bruised, kinked, scored, deformed, or abraded cable.
 - 3. Do not splice cable between indicated termination, tap, or junction points.
 - 4. Remove and discard cable where damaged during installation and replace it with new cable.
 - 5. Pull all cable by hand unless installation conditions require mechanical assistance.
- C. Run all wire and cable continuous from device location to final point of termination. No mid-run cable splices shall be allowed.
- D. Furnish and install all cable such that ample slack is supplied at device terminating end of cable to compensate for any final field modifications in camera location.
 - 1. Loosely coil slack in "Figure-eight" in a manner that prevents kinking.
 - 2. Loop radius shall be at least 4X minimum bend radius for cable.
 - 3. Slack length of cable shall be 4 feet (minimum).
- E. Provide code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs, where penetrations are made by or used for installation of Video System.
- F. Coordinate routing of wire and cable requiring isolation from power, radio frequency (RF), electromagnetic interference (EMI), telephone, etc. with Engineer.
- G. At no time shall any cable be subjected to a bend less than manufacturer's specified minimum radius.
- H. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on Wire and Cable.
- I. Make connections with solder-less devices, mechanically and electrically secured in accordance with manufacturers' recommendations. Wire nuts shall not be an acceptable means of connecting wire and cable.

3.3 IP VIDEO CAMERAS

- A. Mount Video Cameras per project drawings.
- B. Field-verify exact locations and field-of-views with Owner prior to installation.
- C. Provide video camera lenses to accommodate Owner-coordinated field-of-view per camera.
 - 1. Field verify and confirm views with Owner prior to procurement and final installation and adjust camera positions and lens sizes as required upon installation.
- D. Configure resolution, frame rate, password, etc. in system installation, and coordinate with Owner.
- E. Coordinate with Owner prior to installation to confirm required parameters.
- F. Wire interface(s) to external alarms as required.

3.4 NETWORK CONNECTION

Security Cameras will be part of the owner LAN. Connection to the Owner LAN shall be made by Owner IT staff or appointed personnel.

3.5 LABELING AND IDENTIFICATION

- A. Labeling protocols to match all Owner Security System installations.
 - 1. Cabling, Hardware and Equipment shall be clearly labeled using a Code identifying each piece as unique throughout Video Camera System. This code will aid in identifying hardware for servicing and maintenance.
 - 2. Labels and Tags shall be machine-generated using English character set in black ink on white background labels and Tags.
 - a. Self-laminating permanent labels are required on cables; permanent non-marring labels are required on all other hardware/cabinets.
 - b. No hand-written Labels or Tags shall be allowed.
 - c. Dymo or Kroy type adhesive backed lettering is not acceptable.
- B. Identify and tag all cables to denote function.
 - 1. Tag shall indicate:
 - a. System of which cable is a part,
 - b. Indication of cable destination (e.g. room or component), and
 - c. Unique alpha-numeric identifier that distinguishes cable from all others in system.
- C. All labels shall be machine generated. Handwritten labeling is not acceptable.
- D. Label all front panel controls used in normal operation of system using plastic laminate engraved labels or approved equal.
 - 1. Firmly affix to panel or device.
- E. Labeling Formats
 - 1. To be defined by Owner prior to construction following practice for all campus Security System installations.

3.6 SYSTEM TESTING AND ACCEPTANCE

- A. System shall be complete and fully operational before requesting final acceptance and scheduling system testing. This testing is coordinated thru the Owner and Owner representative.
- B. Installation of all field devices will be inspected by Owner or Owner's representative. Inspection will consider overall neatness and quality of installation, functionality of each individual device, mounting, wiring and labeling.
- C. Conduct a seven-day burn-in test. Intent of burn-in test shall be to prove System by placing it in near real operating conditions prior to system acceptance.
 - 1. During this period System shall be fully functional and programmed so that all points, controls, messages, prompts, etc. can be exercised and validated.
- D. Provide written notification to Owner that system is completely installed, integrated, burn-in testing completed and is fully functional as specified herein.
 - 1. Submit schedule for acceptance testing. Representatives of Owner, and/or Engineering representatives may witness test procedures.
 - 2. Notify Owner and the representative in writing a minimum of two weeks in advance to allow for such participation.
 - 3. Describe test procedures prior to testing and submit sample test form to Owner / Representative.

- E. Prior to final acceptance test, equipment rooms and similar areas should be free of accumulation of waste materials or rubbish caused by operations under Contract.
- F. Equipment shall be on and fully operational during any and all testing procedures.
 - 1. Provide all personnel, equipment, and supplies necessary to perform site testing.
 - 2. Supply a form of communication with remote parties in the team for use during test.
 - 3. A manufacturer's representative shall be present on site to answer any questions that may be beyond technical capability of Contractor's employees, if Contractor so elects or by specific request of Representative Owner, at no charge to Representative or Owner.
- G. During course of final acceptance test, Contractor shall be responsible for demonstrating that, without exception, provided VMS complies with contract requirements.
- H. Testing shall include but not be limited to:
 - 1. Continuity and conductor/connector integrity on all cables.
 - 2. Demonstrate functionality of all cameras including:
 - a. Owner-acceptable field of view.
 - b. Response to alarms.
 - c. Response to Access Control System inputs.
 - 3. Confirm remote viewing, configuration and camera control via Browser and in the Control Room. Confirm all Camera views and programming.
 - a. Confirm system rights settings for authorized users.
 - 4. Demonstrate storage and retrieval of recorded video by date/time.
- I. Owner retains the right to suspend and/or terminate testing at any time when system fails to perform as specified.
 - 1. In event it becomes necessary to suspend test, Contractor shall work diligently to complete / repair all outstanding items to condition specified in Specification and as indicated on Drawings.
 - 2. All of Owner's / Representative Fees and expenses related to suspended test will be deducted from Contractor's retainage.
 - 3. Contractor shall supply Owner with a detailed completion schedule outlining phase by phase completion dates and a tentative date for a subsequent punch list retest.
 - 4. During final acceptance test, no adjustments, repairs or modifications to system will be conducted without permission of Owner.
- J. Upon successful completion of final acceptance test (or subsequent punch list retest) Owner or Representative will issue a letter of final acceptance.
- K. Records of Test Results shall be included in System Documentation and submitted as detailed below.

3.7 OWNER TRAINING

- A. Training course for system covered in this section shall be a minimum of 16-hours.
- B. Maximum number of students to be (6).
 - 1. Training materials shall be provided to all students.

- C. Record, label, and catalog all training. Provide copies to Owner for future in-house training sessions and / or reviews. Furnish all temporary equipment necessary for taping all training sessions. Maintain accurate and up-to-date time sheets of all training sessions.
- D. Contractor shall be on call during Warranty period to answer any questions Owner might have. The Owner reserves the right to use any excess training hours, not used by time of system completion, for future training as requested by Owner until total number of training hours has been completed.

3.8 DOCUMENTATION

- A. All Owners manuals and or maintenance information shall be provided in printed form as well as electronic PDF format to the owner and owner representative.

3.9 WARRANTY AND SUPPORT

- A. Unless otherwise noted, Contractor shall guarantee all materials, equipment, etc., one (1) years from date of final Owner acceptance of system. This guarantee shall include all labor, material and travel time.
- B. Contractor/Integrator and/or manufacturer(s) of system equipment must offer:
 - 1. Technical Support Capabilities (Technician onsite) response time onsite within 4 hours, 24- hours/7-days per week ("24/7"), and 365 days per year.
 - 2. 24-hour turn-around (from receipt of item) for Repair or Replacement of failed components, 7-days per week.

END OF DOCUMENT 282300

SECTION 284621 – ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 260010 “General Requirements for Electrical” apply to this Section.

1.2 SUMMARY

- A. Description: This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire detection equipment required to form a complete, operative, coordinated system.
- B. Section Includes:
 - 1. Analog-Addressable fire-alarm system.
 - 2. Fire-alarm control unit (FACU).
 - 3. Manual fire-alarm boxes.
 - 4. System Detectors.
 - 5. Fire-alarm notification appliances.
 - 6. Fire-alarm annunciators.
 - 7. Fire-alarm addressable interface devices.
 - 8. Fire-alarm system communications.
 - 9. Fire-alarm system accessories.
 - 10. Fire-alarm conductors and cabling.

1.3 REFERENCES

- A. Abbreviations and Acronyms
 - 1. DACT: Digital alarm communicator transmitter.
 - 2. FACU (FACP): Fire-alarm control unit (panel).
 - 3. NAC: Notification Appliance Circuit
 - 4. NICET: National Institute for Certification in Engineering Technologies.
 - 5. NRTL: Nationally Recognized Testing Laboratory.
 - 6. SLC: Signaling Line Circuit
- B. Definitions
 - 1. Circuit: Wire path from a group of devices or appliances to a control panel or transponder.
 - 2. Zone: Combination of one or more circuits or devices in a defined building area
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

1. National Electrical Contractors Association (NECA):
 - a. NECA 305, "Standard for Fire Alarm System Job Practices".

1.4 COORDINATION

- A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.5 SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product, including furnished options and accessories.
- C. Shop Drawings: Provide for the fire alarm system.
 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 2. Include floor plans drawn to scale which clearly show locations of devices, equipment. Indicate electrical power connections, approximate location and size of conduit/wiring runs, and other information required to clearly describe the proposed system. Plans should include identification numbers and wiring connections for all equipment and devices in entire fire alarm system.
 3. Include enlarged plans, drawn to a scale not less than 1/4 -inch equals 1 foot, for all equipment rooms and any fire command centers with dimensioned equipment layouts.
 4. Include detailed riser diagrams based on the project floor plans, with all devices indicated along with proposed circuit routing. The conductor composition for each conduit section shall be provided. Show consecutive connections for all devices with addresses, candela ratings, and speaker wattages.
 5. Provide scaled elevations, sections, and details, including critical dimensions and details of attachments to other Work.
 6. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 7. Detail assembly and support requirements.
 8. Annunciator panel details as required by authorities having jurisdiction.
 9. Include current draw for each device submitted and the listed minimum voltage required to operate.
 10. Include voltage drop calculations for notification-appliance circuits. Provide maximum allowable voltage drop for panel and for individual NAC circuits.
 - a. Identify Notification Appliance Circuits (NAC) current draws and voltage drops for each circuit. Vendor must utilize the "end of line" method for voltage drop calculations. The "mid-point" method is not acceptable. In no case shall the calculated voltage at any notification appliance fall below the minimum listed operating voltage for the devices used.
 - b. The voltage drop at EOL must not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. Determine "worst case" voltage at far

- end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. The result must be no less than the minimum listed operating voltage for the alarm notification appliances used. All these calculations must be placed on a dedicated sheet, for future reference by fire alarm service technicians.
11. Include battery-size calculations showing battery capacity and supervisory and alarm standby power requirements.
 - a. Use manufacturer's battery discharge curve to determine expected battery voltage after specified time period of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected voltage drop at End of the Line Resistor (EOL), based on conductor resistance per conductor manufacturer's data sheet or NEC.
 12. Include system response matrix showing the fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal. Any non-compliant features must be fully described.
 13. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 14. Include performance parameters and installation details for each type of detector.
 15. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 16. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Provide control wiring diagrams and show equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
 - c. Locate detectors in accordance with manufacturer's written instructions.
 17. Include equipment rack or console layout, grounding schematic, power calculations, and single-line connection diagram.
 18. Include manufacturer's detailed installation instruction for the Fire Alarm Control Panel and all duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.
- D. Delegated Design: For notification appliances and detectors, in addition to submittals listed herein, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional responsible for their preparation.
1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
 2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 3. Indicate audible appliances required to produce square wave signal per NFPA 72.
- E. Qualification Data: For Certified System Designer, Lead Technician, and Installers including names, license numbers, and certifications as described under Quality Assurance.
- F. Sample Warranty.
- G. Field quality-control reports.

H. Closeout Submittals

1. Operation and Maintenance Data: For fire-alarm systems and components to include in operation and maintenance manuals.
2. In addition to items specified in Division 01 and Section 260010 " Supplemental Requirements for Electrical", include the following:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - d. Software and Firmware Operational Documentation: Provide operating manuals and backups of software database on USB media. The database provided shall be useable by any authorized and certified distributor of the product line, and shall include all applicable passwords necessary for total and unrestricted use and modification of the database.

1.6 MAINTENANCE MATERIAL

- A. Extra Stock Materials: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
 2. Manual Fire Alarm Boxes: 2% of installed quantity.
 3. Audible and Visual notification appliances: 1% of installed quantity for each type.
 4. Addressable Detectors/Bases: 2% of installed quantity for each type.
 5. Addressable Control Relays: 1% of installed quantity.
 6. Monitor Modules (Addressable Interface): 1% of installed quantity.
 7. Isolation Modules/Isolation Bases: 1% of installed quantity.
- B. Keys and Tools: Two extra sets for access to locked or tamper-proofed components.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications
1. Manufacturer must be regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled.
 2. Manufacturer shall maintain an authorized distributor within 100 miles of the project location which stocks a full complement of parts for all equipment to be furnished.
- B. Installer Qualifications

1. Obtain certification by NRTL in accordance with NFPA 72.
 2. Licensed or certified by authorities having jurisdiction to perform fire alarm installations in the specified jurisdiction.
 3. Be in business a minimum of 5 continuous years with documented experience installing fire alarm systems similar in size and scope.
 4. Installer must be responsible for all program changes and must be present for all testing and inspections.
 5. All connections to the FACP and the system's programming shall only be done by the manufacturer, or by an authorized distributor.
- C. Project Personnel Requirements: Installer must have the following certified full-time employees on staff and assigned to the project.
1. All personnel must be trained and certified by manufacturer for installation of units required for this Project.
 2. System Designer: Preparation of shop drawings, cabling administration drawings, and field-testing program development by a NICET certified Level IV technician who shall be trained and certified in fire alarm system design by the approved manufacturer within the last 36 months and be licensed by the authorities having jurisdiction.
 3. Lead Technician: Minimum NICET certified Level III technician who shall provide all devices, connections, and programming for the fire alarm system. Technician shall be certified by the approved manufacturer within the last 36 months and licensed by the authorities having jurisdiction. The lead technician shall be present at all times when work of this Section is performed at the project site.
 4. Installer Qualifications: Any work related to this section shall be installed by personnel trained and certified by the approved manufacturer within the last 24 months.

1.8 WARRANTIES

- A. Manufacturer Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship for a period of 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to the authority having jurisdiction, and marked for intended location and application.
- B. All components provided shall be listed for use with the selected system.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
1. Edwards EST

2. Notifier
 3. Simplex
- B. Being listed as an acceptable Manufacturer in no way relieves obligation of the Contractor to provide all equipment and features in accordance with these specifications.

2.3 ADDRESSABLE FIRE ALARM SYSTEM REQUIREMENTS

- A. Noncoded, UL-certified, FM Global-approved, Networked analog/addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- B. The system shall be designed, inspected, tested and approved to provide occupant notification audibility levels of 15 dBA over ambient conditions. Design intelligibility to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in all areas designated on the drawings to have intelligible audio.
- C. Fire Alarm System shall supervise and monitor the integrity of all sub-systems, circuits, and devices connected to the system and annunciate all system faults. All intelligent initiating, signaling, and control devices shall be individually addressed.
- D. The system shall be fully programmable so that any type of input event can be correlated to any combination of output functions.
- E. The fire alarm system operational priority shall ensure that life safety functions takes precedence over other activities coordinated by the system.

2.4 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors.
 4. Automatic sprinkler system water flow.
 5. Fire standpipe system.
 6. Fire-suppression/extinguishing system operation.
- B. Fire-alarm signal must initiate the following actions:
 1. Continuously operate alarm notification appliances, including voice evacuation.
 2. Identify alarm and specific initiating device at fire-alarm control unit and any remote annunciators or network connected control panels. The system alarm LED shall flash and a local distinct audible signal in the control panel shall sound.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Switch HVAC equipment controls to fire-alarm mode.
 7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 8. Activate emergency lighting control.
 9. Record events in system memory.

10. Record events by system printer.
 11. Indicate device in alarm on graphic annunciator.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Duct smoke detectors.
 3. Device tamper.
 4. Zones or individual devices have been disabled.
 5. High- or low-air-pressure switch of dry-pipe or pre-action sprinkler system.
 6. Elevator shunt-trip supervision for Shut-Down.
 7. Elevator hoistway detectors for Recall.
 8. Fire-suppression/extinguishing system trouble.
- D. System Supervisory Signal Actions:
1. Identify specific device initiating the event at fire-alarm control unit and remote annunciators. The corresponding system LED shall flash and a local distinct audible signal in the control panel shall sound.
 2. Record the event on system printer.
 3. Transmit a supervisory signal to the remote alarm receiving station with no time delay.
- E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of communication with any addressable device or networked panel.
 4. Loss of primary power at fire-alarm control unit.
 5. Ground or a single break in internal circuits of fire-alarm control unit.
 6. Abnormal AC voltage at fire-alarm control units.
 7. Break in standby battery circuitry.
 8. Failure of battery charging.
 9. Abnormal position of any switch at fire-alarm control unit or annunciator.
 10. Voice signal amplifier failure.
 11. Smoke Detector Contamination.
 12. Hose Cabinet Door Open.
- F. System Trouble Signal Actions:
1. Identify specific device initiating the event at fire-alarm control unit and remote annunciators. The system trouble LED shall flash and a local distinct audible signal in the control panel shall sound.
 2. Record the event on system printer.
 3. Transmit a trouble to the remote alarm receiving station after a programmable time delay of 200 seconds or as required by AHJ.
 4. A trouble signal from loss of primary power shall not be transmitted unless maintained after a programmable time delay of 1 to 3 hours or as required by AHJ.
 5. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.

2.5 FIRE ALARM CONTROL PANEL (FACP)

A. General Requirements for Fire Alarm Control Panel:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with NFPA 72 and UL 864, and protected from voltage surges and line transients.
 - a. System software and all control-by-event programs shall be held in nonvolatile memory, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer. Time-of-Day and date shall be retained through failure of primary and secondary power supplies.
 - c. The Central Processing Unit (CPU) shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.
 - d. Provide communication between the FACP and intelligent detectors, addressable modules, local and remote operator terminals, remote circuit interface panels, annunciators, and other system-controlled devices.
 - e. The FACP shall be listed for connection to a central-station signaling system service.
 - f. The system is to have multiple access levels, so owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. A minimum of two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.
2. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
3. The system shall perform time-based control functions including automatic changes of specified smoke detector sensitivity settings.
4. Digitized electronic signals shall employ check digits or multiple polling. In general, a single ground or open on any system signaling line circuit shall not cause system malfunction, loss of operating power, or the ability to report an alarm.
5. Loss of Power: Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, three lines of 80 characters, minimum.
2. Alphanumeric Touch Keypad: Arranged to permit entry and execution of programming, display, and control commands.
3. Color coded system status LEDs. At minimum, Indicate the status of the following system parameters:
 - a. System AC Power
 - b. System Common Alarm
 - c. System Common Trouble

- d. System Supervisory
- e. Signal Silence
- 4. Provide operator's interface which allows the following minimum functions. In addition, the operator's interface shall support any other functions required for system control and/or operation:
 - a. Signal Silence Switch: Silenced audible signal shall resound in a time period acceptable to AHJ if the condition has not been resolved.
 - b. System Reset Switch
 - c. System Test Switch
 - d. Panel Silence Switch
 - e. Panel Lamp Test Switch
 - f. System Bypass Switches: Programmable, supervised switches for fire safety function bypasses. i.e. NAC Bypass, Elevator Capture Bypass, HVAC Shutdown Defeat, Smoke Control Bypass, etc. Switch operation shall be password protected.
 - g. Interface shall allow programming of the system without any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

C. Notification-Appliance and Signaling-Line Circuits:

- 1. Signaling Line Circuits (SLC): NFPA, Class B.
 - a. Provide a minimum of one signaling line circuit per floor.
 - b. Locate end of line resistors
- 2. Notification Appliance Circuits (NAC): NFPA 72, Class B.
- 3. SLC Between Networked Panels: NFPA 72, Class X.
- 4. Door Hold Open control circuits: NFPA 72, Class D for fail safe operation.
- 5. Size each signaling line circuit and notification appliance circuit to allow a minimum additional capacity of 20%.

D. Signaling Line Circuit (SLC) Modules:

- 1. Power limited, capable of accommodating up to 198 addressable devices on each SLC and a minimum of 1980 initiating points per system.
- 2. On-board microprocessor capable of operating in a local mode in the event of a failure in the main CPU of the control panel.
- 3. Capable of receiving analog information from all intelligent detectors and processing the information to determine whether normal, alarm, or trouble conditions exist for specific detectors.
- 4. Automatically maintain detector desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. Analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

E. Notification-Appliance Circuit (NAC) Modules:

- 1. Power limited, minimum circuit output rating: 2 Amps at 24VDC.
- 2. Polarized to provide for both synchronized strobes and independent horn/strobe operation over two wires.
- 3. Selectable as auxiliary power outputs and rated for continuous duty.

F. Network Communication

1. Provide a dedicated fiber optic TCP/IP network utilizing listed network components to interconnect multiple FACP's.
 2. Synchronize panel time, signal patterns, and indicator flash rates across all panels on the network.
 3. In the event of network wiring faults, each panel on the network shall re-configure into a sub-network and continue to respond to alarm events.
- G. Digital, Multiplexed Voice/Alarm Signaling: Emergency communication system, integral to FACP, with master and remote microphones, zoned amplifiers, and tone generators that provide both live and pre-recorded messages.
1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the microphones. Amplifiers shall comply with UL 1711. Group speakers into zones as required by building code.
 - a. Allow the application of, and evacuation signal to, multiple zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Provide standard digitally recorded messages for the following:
 - 1) Evacuation
 - 2) All Clear
 - 3) Weather warning
 - 4) Test
 - 5) Stand-by
 - d. Generator tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits.
 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones.
 3. Amplifiers and tone generators shall automatically transfer to backup units, on primary equipment failure.
- H. Serial Interfaces:
1. One USB port for system printer.
 2. One USB or Ethernet port for on-site programming or system modification with a PC.
- I. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- J. Elevator Recall and Shutdown:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room/space or control room/space.
 - c. Smoke detectors in elevator hoist way.

2. Program elevator controller to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
3. Heat Detectors or Water-flow alarm associated with sprinklers in an elevator shaft and elevator machine room shall remove power to elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- K. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to and powered by fire-alarm system.
- L. Remote Smoke-Detector Sensitivity Adjustment and Testing: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out final adjusted values on system printer. The system shall also annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, with an annunciation of the location of the smoke detector requiring service. If any specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.
- M. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station in accordance with parameters specified herein.
- N. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- O. Primary Power: Obtained from dedicated 120-V ac branch circuit and a high efficiency power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 1. Power supply modules shall have a continuous rating adequate to power all equipment and functions in full alarm continuously. All modules and drivers must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage. The power supply shall be expandable for additional notification appliance power in 3.0 Ampere increments.
 2. Each system power supply shall be individually supervised.
 3. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating to allow for future system expansion.
 4. Install lock clips on circuit breakers in the "ON" position.
- P. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.

1. Batteries: Maintenance-free, rechargeable, sealed, lead acid with rated lifespan of 10 years.
 2. Provide sufficient capacity to operate the complete alarm system in normal, supervisory, or trouble conditions, including audible trouble signal devices, mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 15 minutes. Battery capacity must include a 25% safety factor.
 3. Locate batteries either within the control panel or in a separate substantial steel cabinet, finished on inside and outside with enamel paint. Provide a cylinder lock keyed to match FACP. Separate cells to prevent contact between terminals of adjacent cells and between terminals and other metal parts.
 4. Battery Charger: Provide solid state automatic float type, capable of dual rate charging techniques that will recharge a fully discharged battery to a minimum 70% capacity in 12 hours or less. Locate charger within the control panel or within the battery cabinet. Provide voltmeter and ammeter to indicate battery voltage and charging current.
 5. All standby batteries shall be continuously monitored by the power supply. The power supply shall be able to perform an automatic test of batteries and indicate a trouble condition if the batteries fall outside a predetermined range.
- Q. Enclosure: Provide the FACP with a listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).
- R. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.6 REMOTE POWER SUPPLIES

- A. Stand-alone panel capable of powering a minimum of four synchronized NACs. Power limited, 24 VDC, filtered-regulated, and supervised. Configurable as a continuous 24VDC auxiliary power output.
- B. Alarms from the host fire alarm control panel shall signal the NAC remote power supply panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.
- C. Internal Primary and Secondary power supplies: comply with performance requirements for FACP.

2.7 MANUAL FIRE ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type with visual indicator of operation; with screw terminals and integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control panel. When the station is operated, the handle shall lock in a manner showing visual indication of operation.
2. Station Test/Reset: Key-operated test/reset switch. Stations shall be keyed alike with the fire alarm control panel.
3. Manual pull stations that initiate an alarm condition when opening the unit are not acceptable.
4. Material: High impact Lexan Polycarbonate or Cast Metal.
5. Suitable for ambient temperatures up to 120 deg F.
6. Where required, provide weatherproof backbox and device listed for outdoor applications.

2.8 SYSTEM DETECTORS

A. General Requirements:

1. Operating Voltage: 24VDC, nominal. Two-wire type.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACP through a SLC.
3. Device Identification: Detectors shall permanently store an internal identifying type code that the control panel shall use to identify the type of device.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: dual LED type. LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the control panel. The flashing mode operation of the detector LEDs shall be optional through the system field program.
7. Automatic Device Mapping: Detector address must be accessible from FACP and must be able to identify detector's location within system and its sensitivity setting.
8. Detectors shall be rated for operation in the following environment unless noted otherwise:
 - a. Temperature: 32 deg F to 120 deg F
 - b. Humidity: 0-93% relative humidity, non-condensing
9. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Multiple levels of detection sensitivity for each sensor.
 - b. Sensitivity levels based on time of day.
 - c. Automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors.
10. Test Means: Provide a test means whereby detectors will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself or initiated remotely on command from the control panel when in the "test" condition.

B. Photoelectric Smoke Detector: Comply with UL 268.

1. Intelligent photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

2. Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure.
 - a. Provide a maintenance alert signal when 80% of the available compensation range has been used.
 - b. Provide a dirty fault signal when 100% or greater compensation has been used.
 3. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor compensation range (normal, dirty, etc.).
- C. Duct Smoke Detector: Comply with UL 268A.
1. Listed for air velocity, temperature, and humidity present in specific duct application with standard Intelligent Photoelectric Detector and detector mounting base.
 2. Duct Housing Enclosure: NRTL listed for use with supplied detector for smoke detection in HVAC system ducts. Provide gasketed NEMA 4X housing for harsh environments.
 3. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 4. Relay Fan Shutdown: Fully programmable supervised relay rated to interrupt fan motor-control circuit.
- D. Heat Detector: Comply with UL 521.
1. Heat detectors shall use an electronic sensor to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.
 2. Fixed Temperature Type: Actuated by fixed temperature of 135 deg F unless otherwise required.
 3. Combination Type: Actuated by fixed temperature of 135 deg F or rate of rise that exceeds 15 deg F per minute unless otherwise required.
 4. Rated for ceiling installation at a minimum of 50 ft centers and suitable for wall mount applications.
- E. Multicriteria Detector
1. Integrated nuisance rejection to reduce unwanted alarms.
 2. Provide independent signals to the control panel for detectors with CO sensors.
- F. Detector Bases: Suitable for mounting to standard 4-inch octagon or square outlet boxes.
1. Standard Base: Twist lock, suitable for all intelligent detectors. Provided with integral terminal strips for circuit connections, rather than wire pigtails. Capable of supporting a remote alarm indicator light.
 2. Relay base: Includes programmable, supervised relay, configurable for control with attached detector or from the FACP. Minimum contact rating of 1 amp at 30VDC and listed for pilot duty.
 3. Sounder Base: Includes piezoelectric sounder with configurable low or high output, programmable operation, listed to UL 268. Produces Temporal Code 4 tone for CO detectors and Temporal Code 3 tone for all other detectors. or low frequency 520Hz signal tone patterns.

4. Low Frequency Sounder Base: Emits 520Hz tone as defined by NFPA 72 for sleeping areas, listed to UL 268 and UL 464.
5. Isolator Base: Includes integral isolation module.

2.9 NOTIFICATION APPLIANCES

A. General Requirements

1. Connected to system notification-appliance signal circuits, zoned as noted, equipped for mounting as indicated, and with in and out screw terminals for system connections.
2. All visual appliances shall be synchronized. Light and audible output levels shall be designed to meet ADA and NFPA requirements.
3. Audible/Visual Combination Devices shall comply with all applicable requirements for both Audible Notification and Visible Notification Appliances.
4. Devices located in a damp or wet location shall be listed for environment. Exterior mounted devices shall be provided with a weatherproof backbox.
5. Devices located in sleeping areas shall produce a low frequency alarm signal that has a fundamental frequency of 520Hz +/- 10% and shall be a square wave.
6. All notification appliances shall be factory finished red unless noted otherwise on the drawings

B. Fire Alarm Audible Notification Appliances:

1. Description: Electric vibrating polarized Horns or other notification devices that cannot output voice messages.
2. Performance Criteria: Comply with UL 464.
3. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
4. Locate audible devices to provide audibility requirements of "Notification Appliances" chapter in NFPA 72.
5. Voltage: 24VDC nominal
6. Mounting: Flush mount on a standard electrical box.
7. Minimum rated sound pressure level of 85dBA at 10 feet for a three pulse temporal pattern.

C. Fire Alarm Voice-Tone Notification Appliances:

1. Description: Notification appliances capable of outputting voice evacuation messages.
2. Performance Criteria: Comply with UL 1480.
3. Voice-tone appliances shall sound in a three-pulse temporal pattern with a minimum of two cycles preceding and following the voice message, as defined in NFPA 72.
4. Speakers for Voice Notification: Locate speakers for voice notification to provide intelligibility requirements of "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
5. Speaker Operating Voltage: 25V or 70V.
6. Mounting: Flush mount on a standard electrical box.
7. Minimum rated sound pressure level of 84dBA at 10 feet for 1-watt tap.
8. Matching Transformers: Tap range at 1/4-watt, 1/2-watt, 1-watt, and 2-watt, selected to match acoustic environment of speaker location. Speakers shall be tapped at 1 watt for design purposes.

D. Fire Alarm Visible Notification Appliances: LED strobe lights with clear high impact polycarbonate lens mounted on an aluminum faceplate, complying with UL 1971. The word "FIRE" is engraved in minimum 1-inch- high letters on the housing.

1. Rated Light Output: 15/30/75/110cd or 135/177/185cd, switch selectable at the device. Selected strobe rating shall be visible when the horn-strobe is in its installed position.
 2. Voltage: 24VDC nominal
 3. Mounting: Wall or ceiling mounted to standard electrical box unless otherwise indicated.
 4. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 5. Flashing shall be in a temporal pattern, synchronized with other units. Maximum pulse duration: 2/10ths of one second.
 6. Strobe Leads: Factory connected to screw terminals.
- E. Bell: Vibrating under dome type with 10-inch gong, utilize a heavy-duty mechanism, polarized for supervised operation.
1. Voltage: 24VDC nominal.
 2. Mounting: Semi-Flush mount on a standard electrical box.

2.10 ANNUNCIATORS

- A. Fire Alarm Remote Annunciator
1. Description: Annunciator functions must match those of FACP for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACP, including acknowledging, silencing, resetting, and testing.
 2. Mounting: Flush cabinet, NEMA 250, Type 1.
 3. Annunciator shall communicate with the fire alarm control panel via a supervised RS-485 communications loop that supports multiple annunciators and shall individually annunciate all zones in the system.
 4. Display Type and Functional Performance: Large format LCD Alphanumeric display and LED indicating lights must match those of FACP. Provide manual control switches to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
 5. Power shall be supplied directly from the FACP or listed auxiliary power supply, ensuring a reliable and monitored power source.
- B. Fire Alarm Graphic Annunciator Panel: Mounted in aluminum frame with nonglare, minimum 3/16-inch thick, clear acrylic cover over graphic representation of facility. Detector locations must be represented by red LED lamps. Normal system operation must be indicated by lighted, green LED. Trouble and supervisory alarms must be represented by amber LED.
1. Comply with UL 864.
 2. Operating voltage must be 24 VDC provided by local battery backed up 24 V power supply provided with annunciator.
 3. Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and lamp test switch.
 4. Semi flush mounted in NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.
 5. Graphic representation of facility must be CAD drawing and each initiating device must be represented by LED in its actual location. CAD drawing must be at 1:100 scale or larger.
 6. LED representing detector must flash two times per second while detector is in alarm.

2.11 ADDRESSABLE INTERFACE DEVICES

A. General Requirements:

1. Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and control of building systems.
2. All Circuit Interface Devices shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions.
3. Equip each module with two (2) diagnostic indicators; a green LED to confirm communications and a red LED to display active status. LEDs shall be visible through the finished cover plate. The module shall be capable of storing a unique serial number and up to 24 diagnostic codes, hours of operation, number of alarms and troubles, and time of last alarm in its memory which can be retrieved for troubleshooting.
4. Include electronic address-setting means on the module.

B. Monitor Module: Microelectronic module providing system address for alarm-initiating devices in wired applications with normally open contacts.

1. Supervision: Unless specifically noted otherwise on the drawings provide one monitor module for each sprinkler flow, tamper, and pressure switch.

C. Control Relay Module: For control of auxiliary devices or equipment.

1. Provide form C dry relay contacts rated 24VDC at 2 amps.

D. Isolation Module: For short circuit protection on signaling line circuits.

1. When a short circuit is detected, the module isolates the affected segment on the circuit, allowing the remaining devices to continue functioning.
2. Self-restoring and automatically reconnects to the circuit segment when the fault is removed.
3. SLC isolation shall be provided for each floor or protection zone of building.

2.12 DIGITAL ALARM COMMUNICATIONS

A. UL 864 listed as conforming to the requirements of NFPA 72 for Central Station connections.

B. Digital alarm communications transmitter (DACT): capable of sending system events to remote central station receivers over conventional telephone lines.

1. Dual telephone line, rotary or touch-tone-dial DACT interface to public switched telephone network

C. IP/Cellular digital alarm communications transmitter (IP DACT): capable of sending system events to compatible remote central station receivers over a cellular or IP path.

1. UL 864 listed as conforming to the requirements of NFPA 72 for Central Station connections.
2. TCP/IP Ethernet Communicator supporting encrypted communications.
3. Cellular Communicator: LTE fall back cellular connection through the cellular module. Provide antenna extension kits where required to ensure a high-quality connection.

D. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture a transmission line and dial a preset number for a

remote central station. When contact is made with central station(s), signals shall be transmitted. If primary service is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of primary line to the remote alarm receiving station over the remaining transmission line. Transmitter shall automatically report transmission channel restoration to the central station. If service is lost on both transmission channels, transmitter shall initiate the local trouble signal.

- E. Digital Data Transmission must include the following at a minimum:
 - 1. Address of alarm-initiating device.
 - 2. Address of supervisory signal.
 - 3. Address of trouble-initiating device.
 - 4. Loss of ac supply, where exceeding programmable time delay.
 - 5. Loss of power.
 - 6. Low battery.
 - 7. Abnormal test signal.
 - 8. Communication bus failure.
- F. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Supervised communications.
 - 2. Programmable
 - 3. Auxiliary relay to indicate alarm or trouble.
 - 4. LED display with audible trouble alarm.
 - 5. Manual test report function and manual transmission clear indication.
 - 6. Communications failure with the central station or fire-alarm control unit.
- G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 SYSTEM ACCESSORIES

- A. Magnetic Door Holders: wall or floor mounting and complete with matching doorplate. The door portion shall have a plated steel pivot mounted armature with shock absorbing nylon bearing. Material and finish to match door hardware.
 - 1. Operation: Under normal conditions, the magnets shall attract and hold the door open. Upon activation of the building fire alarm system, the devices shall be de-energized, thus releasing the doors on the circuit.
 - 2. Electromagnets: Require no more than 1 W to develop 35-lbf holding force.
 - 3. Wall-Mounted Units: Flush mounted in a single gang electrical box unless otherwise indicated.
 - 4. Rating: 24-V dc operating on power from the fire alarm control panel.
 - 5. Power source shall be supervised.
 - 6. Door hold open magnets shall be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings.
 - 7. Operation: Under normal conditions, the magnets shall attract and hold the door open. Upon activation of the building fire alarm system, the devices shall be de-energized, thus releasing the doors on the circuit.
- B. Surge Suppression Devices:

1. AC circuits: UL 1449 listed, 120VAC, 20A branch circuit surge suppressor with EMI filtering. Ditek DTK-DF120S1 or equal. Shunt type devices are not permitted.
 2. DC circuits: UL 497B listed, 24VDC, 5A multi stage hybrid design surge suppressor. Ditek DTK-2MHLP or equal. Devices using only MOV active elements are not permitted.
- C. Remote Alarm Indicator Lights: Key type switch for testing of the annunciated device.
- D. Terminal Cabinets: Steel cabinet with red finish, hinged lift-a-way cover, barrel key lock, terminal identification labels, and listed terminal blocks for up to 120 high barrier termination points. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type. Provide "FIRE ALARM TERMINAL CABINET" label in permanent lettering on the enclosure cover
- E. Documentation Cabinet: Steel cabinet with red finish, hinged cover, barrel key lock, key ring hooks for spare keys, and USB storage device for backup documentation. Sized to accommodate standard 8 1/2 by 11 Operation and Maintenance manuals, As-Built Drawings, Completion Documents, and Inspection and Testing Form required by NFPA 72. Provide "SYSTEM RECORD DOCUMENTS" label in permanent lettering on the enclosure cover.

2.14 FIRE ALARM CONDUCTORS AND CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Allied Wiring and Cable
 2. Belden
 3. Comtran Corporation
 4. General Cable
 5. Honeywell Genesis
 6. Radix Wire & Cable
 7. Southwire
 8. Superior Essex
 9. West Penn Wire
- B. General Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
1. Type FPLR or FPLP, red jacket, suitable for indoor locations.
 2. Type PLTC, suitable for underground or wet locations.
 3. Twisted, shielded pair, low capacitance, not less than No. 18 AWG unless recommended otherwise by system manufacturer.
 4. Circuit Integrity Cable: Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
 5. Multiconductor Metal Clad Cable: NFPA 70, Type MC/FPLP, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, steel armor with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. All equipment supplied must be specifically listed for its intended use and shall be installed in accordance with the manufacture's recommendations. The contractor shall consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- B. Comply with NECA 305, NFPA 70, NFPA 72, and requirements of AHJ for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- C. Securely fasten all system components to wall and ceiling assemblies using fasteners and supports rated to support the required load in accordance with Section 260500, "Supplemental Requirements for Electrical".
 - 1. Ceiling mounted devices shall not be supported solely by suspended ceilings.
- D. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above finished floor. Locate annunciators at a height that enables easy viewing.
- E. Provide additional remote NAC power supplies as required to comply with voltage drop requirements.
- F. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm boxes in the normal path of egress within 60 inches of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- G. Notification Devices:

1. Comply with NFPA 72 and ADA criteria for strobe visual intensity, audible appliance intelligibility, and final device placement.
 2. Install wall devices with entire lens between 80-inches and 96-inches above the floor but not less than 6 inches below the ceiling. Install devices on flush-mounted back boxes with the audible device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- H. End of Line (EOL) Resistors: Label devices containing end-of-line resistors with NAC panel and circuit number in such a manner that removal of the device is not required to identify the EOL device. Locate EOL devices in a readily accessible location no more than 12-feet above finished floor.
- I. Smoke and Heat Detectors:
1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 3. Smooth ceiling spacing for smoke detectors shall not exceed 30 feet except in corridors where increased spacing are allowed in accordance with NFPA 72.
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
 5. HVAC: Locate detectors not closer than 36 inches from diffusers or return-air openings.
 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
 7. When installed in a room, detectors shall be oriented, so their alarm light is visible from the nearest door to the corridor.
 8. Unless suitably protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors must be replaced by the contractor at no additional cost to the Owner. Covers supplied with smoke detector heads do not provide protection against heavy construction dust, spray painting, etc., and must not be used for that purpose. They are suitable only during final, minor cleanup or touchup operations.
- J. Duct Smoke Detectors:
1. Provide duct smoke detectors for the following locations:
 - a. At all smoke dampers.
 - b. At all HVAC units (AHUs, OA units, Heat Pump Units, etc) with fans greater than 2,000 CFM.
 - c. At each story, prior to the duct connection at a common return, for air distribution systems with a combined capacity greater than 15,000 CFM serving more than one story.
 - d. Additional locations required by the Building Code.
 2. Comply with NFPA 72, IMC, and NFPA 90A for HVAC unit shutdown and closing of smoke dampers.
 3. Install sampling tubes so they extend the full width of duct.
 4. Support tubes more than 36 inches long at both ends.
 5. Extend the intake tube through the far side of the duct, seal around the tube where it penetrates the duct wall and plug the end with a rubber stopper to facilitate visual inspection and intake tube cleaning.

6. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to final acceptance.
7. Locate duct detectors in a manner that provides suitable, convenient access for required periodic cleaning and calibration.
8. Comply with manufacturer's requirements for clearances from HVAC equipment and duct accessories such as humidifiers.
9. Provide number of detectors per duct in accordance with NFPA 72 requirements based on the size of the air duct, air duct configuration, air speed, and duct manufacturer's installation requirements.
10. Indicate airflow direction on the duct, adjacent to the detector, using stencil or permanent decal.
11. Provide each duct smoke detector with a remote keyed test switch and alarm indicator.

K. HVAC Unit Shutdown

1. Provide control relays for HVAC unit shutdown at the following minimum locations:
 - a. For all fans associated with HVAC units (including fan powered VAVs) connected to an air distribution system with a combined capacity greater than 2,000 CFM. Shut down fans upon activation of the associated smoke detector(s).
 - b. For all High Velocity Low Speed (HVLS) ceiling fans. Shut down fans upon activation of sprinkler system water flow alarm.
2. Comply with NFPA 72, IMC, and NFPA 90A for supervision and control of HVAC unit shutdown components.
3. All shutdown relays shall be directly controlled and monitored by the fire alarm system. Wire relays for fail safe operation.
4. The Building Automation System (BAS) shall not be used for life safety functions unless the BAS is supervised by the Fire Alarm System for off normal conditions.

L. Elevator Hoistway and Machine/Control Rooms and Spaces: Provide initiating devices and elevator controls interface to comply with NFPA 72 and ANSI A17.1 elevator code requirements for elevator recall and shutdown.

1. Coordinate initiating device temperature ratings, sensitivity settings, and location with sprinkler rating and location. Select temperature rating nominal 10 degrees F less than the adjacent fire sprinkler.
2. Ensure device operating ranges for temperature and humidity are suitable for installed environment. Do not install smoke detectors in unsprinklered elevator hoistway unless required otherwise by AHJ.

M. Addressable Interface Devices:

1. Addressable interface and control modules (used to monitor all contact type initiating devices) must be in a conditioned space, unless they are tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed location.
2. Sprinkler system supervisory circuits for monitoring valve position, air pressure, water temperature, pump status, etc., must cause distinct audible and visible indications at the FACP.
3. Install interface devices used to initiate emergency control functions no more than 36 inches from the component controlling the emergency control function.

N. Isolation Modules: Provide in the following locations to minimize the impact of wiring faults:

1. After each 50 initiating devices and control points on the addressable loop, or a lesser number where recommended by the manufacturer.
 2. Near the point any addressable circuit extends outside the building, except for those attached to the building exterior walls and well sheltered by walkways.
 3. For loops covering more than one floor, install isolator at terminal cabinet on each floor with additional isolator[s] on any floor with over 50 addresses.
 4. Each isolation module must be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling).
- O. Independent fire-suppression/extinguishing systems
1. Provide interface modules and all control unit connections required to supervise fire-suppression and extinguishing system indicated on drawings.

3.3 PATHWAYS AND CONDUCTORS

- A. Wiring Methods: Install all fire alarm wiring in metal conduit, minimum 3/4-inch, in accordance with Section 260533, "Raceways and Boxes for Electrical Systems" and manufacturer's recommendations. Conceal raceway, except in unfinished spaces.
1. MC Fire Alarm cable is permitted for fire alarm wiring in concealed locations not subject to physical damage.
 2. Unenclosed wiring methods may be used in accessible ceiling spaces.
 3. Install plenum rated cable in environmental air spaces, including plenum ceilings.
- B. Provide red finish for fire alarm raceways in assessable areas above ceilings, and exposed unfinished spaces. Match adjacent architectural finish for exposed fire alarm raceways in finished areas with red junction box covers.
- C. All junction box covers shall be painted red on both sides to designate use for Fire Alarm conductors. The interior of junction boxes shall not be painted.
- D. Where allowed, surface boxes shall be as manufactured by the device manufacturer for the installed device and shall match devices in size.
- E. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices will not be permitted. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
- F. For underground raceways and other wet locations, provide moisture resistant PLTC cable.
- G. All fire alarm and communications circuits that are run underground or beyond the building footprint shall be provided with a surge protective device at both ends of the circuit.
- H. All circuits leaving the riser on each floor or building zone shall feed through a labeled terminal block in a terminal cabinet accessible from the floor.
- I. T-Taps are not permitted for Class B circuits. Locate end of branch devices in a readily accessible location.

3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements Door Hardware Spec. Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Coordinate connections to electronic access-controlled doors with door hardware specifications and actual door hardware. Provide all connections for release of locking mechanisms in egress paths as required.
- C. Verify exact connection requirements to all equipment and devices of other trades with those trades prior to ordering equipment.
- D. Make addressable connections with a supervised interface device to controlled or monitored devices and systems. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

3.5 IDENTIFICATION

- A. Comply with the following requirements
 - 1. Identify system components, wiring, cabling, and terminals. Identify all fire alarm circuits at terminal and junction locations.
 - 2. Install a nameplate on each fire alarm panel and power supply to indicate the equipment designation, panelboard and circuit number supplying the fire alarm equipment.
 - 3. Branch circuit overcurrent protective devices powering fire alarm equipment shall be identified as FIRE ALARM CIRCUIT with a red and white engraved label permanently affixed to the equipment.
 - 4. Provide engraved label for each remote alarm indicator.
 - 5. Label all addressable control modules to identify their function.
- B. Basic operating instructions shall be framed and permanently mounted at the FACP. (If the owner concurs, they may instead be affixed to the inside of the FACP's door.) In addition, the NFPA 72 "Record of Completion" must either be kept at the FACP, or its location shall be permanently indicated there by an engraved label. All System documentation shall be provided and housed in a Documentation Cabinet at the control panel or other approved location in accordance with NFPA 72.

3.6 GROUNDING

- A. Ground FACP and surge protective devices for associated circuits in accordance with Section 260526, "Grounding and Bonding for Electrical Systems".
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

- A. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- B. Coordinate all testing in occupied buildings with the owner's representative to minimize the disturbance to the building occupants.
- C. Visual Inspections: Conduct prior to testing.
 - 1. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - 2. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
- D. Preliminary Testing
 - 1. Check all wiring for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be 10 megohms, as verified with an insulation tester.
 - 2. Ensure all devices and circuits are functioning properly in accordance with manufacturer's requirements.
- E. System Acceptance Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 1. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
 - 2. Verify candela settings and test visible appliances for public operating mode in accordance with manufacturer's written instructions.
 - 3. Test all site-specific software functions and provide a detailed report showing the system's operational matrix. Each initiating device shall activate the proper response and system notification.
 - 4. Verify all other system functions, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc.
 - 5. Verify digital communicators are on-line and tested for proper communication to the receiving station.
 - 6. All supervised circuits must also be tested to verify proper supervision.
 - 7. Verify the voltage drop of each NAC circuit by testing and recording the voltage at the origin and at the EOL for each NAC circuit, under battery power only.
- F. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances, software modification, or wiring modifications. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.
- G. Final Acceptance Test: Complete record drawings and system operation matrix are required prior to scheduling final acceptance test.
 - 1. The owner's representative, monitoring service, and fire department shall be notified before final tests in accordance with local requirements.

2. Operate every device to verify proper operation and correct annunciation.
 3. Open signaling line circuits and notification appliance circuits in at least two locations to verify proper supervision.
- H. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- I. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72. Submit certified results to the AHJ, Owner, Architect, and Engineer.
- J. Prepare test and inspection reports.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.
- B. The manufacturer's authorized representative must instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 8 hours on-site time will be allocated for this purpose. Two copies of a written, bound summary will be provided, for future reference.
- C. Training shall cover as minimum the following topics:
1. Preventive maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
 2. Overall system concepts, capabilities, and functions. Training shall be in depth, so that the owner shall be able to take any device out of service and return any device to service without need of Manufacturer's approval or assistance.
 3. Explanation of all control functions, including training to program and operate the system software.
 4. Methods and means of troubleshooting and replacement of all field wiring devices.
 5. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
 6. Manuals, drawings, and technical documentation. Actual system software used for training shall be provided in digital form and shall be left with the Owner at the completion of training for the Owner's use in the future.
- D. A receipt shall be obtained from the Owner that this has been accomplished, and a copy included in the close-out documents.

END OF SECTION – 284621